# SCIENCE ABSTRACTS.

## Section A.—PHYSICS.

**NOVEMBER, 1931.**

## GENERAL PHYSICS.

**3669. Multiple Manometer and Piston Gauges for Precision Measurements. C. H. Meyers and R. S. Jessup.** *Bureau of Standards, J. of Research,* 6. *pp.* 1061–1102, *June,* 1931.—A differential mercury manometer reading to 15 atmospheres is described, consisting essentially of five U-tubes in series. It is accurate to 1 part in 10,000. The piston gauges are also capable of this degree of accuracy, provided they are calibrated from time to time. To avoid friction effects, the piston and its load are kept in rotation in the cylinder. J. H. A.

**3670. Metering of Large Volumes of Air. H. S. Bean, M. E. Benesh and E. Buckingham.** *Bureau of Standards, J. of Research,* 7. *pp.* 93–145, *July,* 1931.—The investigation comprised the following three kinds of experiment: (*a*) Experiments on the flow of air from a large gas holder through a rotary displacement gas meter of 200,000 cu. ft. per hour rated capacity, a 24 by 12 in. Venturi meter, and various thin-plate orifices installed in a smooth 24-in. pipe. The rate of flow was determined from observations on the holder, which was flooded by a stream of water to control the temperature. The average precision of a determination was better than ± 0·5 %. (*b*) Series comparisons of the orifices with the Venturi, without using the holder. (*c*) Observations on the distribution of static pressure along the wall of the pipe near the orifices, at various rates of flow. The apparatus, experimental procedure, and methods of computation are described, and tables of results are given. The rate of flow shown by the rotary displacement meter agreed with the rate computed from observations on the holder to within about 0·5 %; and the discharge coefficient found for the Venturi was in good agreement with earlier published values for similar Venturis, tested with water. When the values obtained for the discharge coefficients of the orifices were so reduced as to be comparable with the most complete and accurate published values for water, the agreement was very satisfactory.
AUTHORS.

**3671. Standards of Measurement: History and Development. R. T. Glazebrook.** *Phys. Soc., Proc.* 43. *pp.* 412–457, *July,* 1931. *Nature,* 128. *pp.* 17–28, *July* 4, 1931. *Supplement, Guthrie Lecture.*—Gives an historical account of standards of weights and measures, from the time of the Chaldæans, Sumerians, Egyptians and Greeks onward. Standards of time and electrical standards are briefly dealt with, and some attention is given to the proposal to adopt the wave-length of the red line of cadmium as a " natural " standard of length, by means of which arbitrary standards, such as the metre and the yard, can at any time be reproduced in case of loss or injury. H. N. A.

**3672. Knife-Edge or Hatchet Planimeter. F. B. and L. C. Haynes.** *Rev. Sci. Instruments,* 2. *pp.* 396–400, *July,* 1931.—A mathematical investigation into the theory of this instrument. G. E. B.

**3673. Revision of the Density of Nitrous Oxide. T. Batuecas.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 78–84, 1931. *In French.*—The mean of 20 determinations of the density of nitrous oxide, prepared by different methods, is 1·9804 ± 0·00005 gm. per litre; this value is about 0·1 % higher than those found by Leduc, Rayleigh and other workers. H. F. G.

**3674. Capillary Activity in Aqueous Solutions. H. Mills and P. L. Robinson.** *Chem. Soc., J. pp.* 1629–1648, *July,* 1931.—An investigation to discover a numerical relation between the depression in surface tension brought about by solution of certain substances in water and the molecular properties of these solutes. To obtain sensitivity for the surface tension concentration curves a modified method of maximum bubble pressure seems to give the most accurate results. Solutions of surface-active solutes divide readily into two types which differ essentially in the relative values of surface and bulk concentration of the dissolved materials. When the surface concentration is greatly in excess of the bulk concentration, the process of surface adsorption can be followed semi-quantitatively, the relationship between concentration and maximum adsorption can be demonstrated, and data for the surface tension concentration of a solution in which surface adsorption has reached its maximum can be given. H. M. B.

**3675. Micro-Method for the Measurement of Surface Tension. H. Mouquin and S. Natelson.** *J. Phys. Chem.* 35. *pp.* 1931–1934, *July,* 1931.—A new micro-method for the determination of surface tension is described. It is particularly suitable for volatile liquids, and requires, other than a common microscope, only the simplest materials; it is thus universally applicable. Comparison with current macro-methods, for such liquids as are suitable, shows accurate agreement. H. M. B.

**3676. Variation of the Surface Tension of Water at Glass Plates of Increasing Thickness. B. N. Srivastava.** *Kolloid Zeits.* 56. *pp.* 45–49, *July,* 1931.—This paper describes experiments with the Searle tensiometer and, from the data obtained, it is shown that the total force exerted by the liquid surface on a glass plate may be expressed as the sum of two forces which are proportional respectively to its area and content. The theoretical discussion is given separately by **S. Ray** (*ibid.,* pp. 49–51, July, 1931), based on the colloidal theory of surface tension. H. H. Ho.

**3677. Motion of a Rectilinear Vortex. A. Masotti.** *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 464–467, *May* 17, 1931.—From a formula for the kinetic energy of a circulating current is deduced the following energy-property of the motion of a rectilinear vortex in presence of a cylindrical wall to which the vortex is parallel. Considering a circumference with its centre in the track of the vortex, and having a very small radius, this is permanently a line of flow; during the movement of the vortex the kinetic energy of the current which flows between the said circumference and the cylindrical wall remains constant. The same kinetic energy, changed in sign, is the potential of the resultant of the dynamical actions on unit of length of a fixed thin cylinder whose cross-section is the said circumference. A. D.

**3678. Reciprocity Relation in Hydrodynamics. A. Masotti.** *Pont. Accad. Sci., N. Lincei, Atti*, 84. *pp.* 468–478, *May* 17, 1931.—Let there be a rectilinear vortex, in presence of a cylindrical wall, to the genetrices of which it is parallel. The motion induced in the liquid bounded by the cylindrical wall is plane and irrotational. Let $M_1$ be the trace of the vortex on a plane normal to the vortex, and let $V_{12}$ be the velocity induced at another point $M_2$. Consider $M_2$ as the trace of a vortex with the same intensity as the preceding, and let $V_{21}$ be the velocity induced by this vortex at $M_1$. Then we have $V_{12}/V_{21} = \epsilon^{G_2}/\epsilon^{G_1}$, in which $G_1$ and $G_2$ are the values which Green's preliminary functions relative to the points $M_1$ and $M_2$ assumed at the respective poles. A. D.

**3679. Impossibility of Wave-Propagation in Viscous Fluids. G. Lampariello.** *Accad. Lincei, Atti*, 13. *pp.* 688–692, *May* 3, 1931.—In general, wave-propagation with viscous fluids is impossible (P. Duhem, *Recherches sur L'Elasticité*, 1906); here it is simply proved from the general theory of Hadamard and Levi-Civita's characteristic varieties of systems of equations with partial derivatives. This is not to say that viscosity always excludes wave-propagation: consider a wire exposed to a viscous air resistance; the equation will be $\frac{1}{V}\frac{\partial^2\phi}{\partial t^2} - \frac{\partial^2\phi}{\partial x^2} + \lambda\frac{\partial\phi}{\partial t} = 0$, where $\phi(t, x)$ is the displacement; there will be wave-propagation because this equation has the same Hadamard characteristics as the viscosity-free equation $\frac{1}{V}\frac{\partial^2\phi}{\partial t^2} - \frac{\partial^2\phi}{\partial x^2} = 0$. A. D.

**3680. Various Methods of Contraction of a Filament at the Outflow from a Tube. C. Camichel and P. Dupin.** *Comptes Rendus*, 193. *pp.* 102–103, *July* 15, 1931.—For a viscous liquid the authors find with low Reynolds numbers no contraction of filaments. With increasing Reynolds number it is found that successively (1) contraction of the filaments varies with the Reynolds number; (2) vortices appear, and (3) a surface of discontinuity appears and the contraction is constant. (3) was found to hold for speeds of 15–70 cm./sec. for a rectangular aperture of 3 × 12 cm. The several types of flow are illustrated. R. S. R.

**3681. Viscous Layer Associated with a Circular Cylinder. J. J. Green.** *Phil. Mag.* 12. *pp.* 1–41, *July*, 1931.—The validity of the Prandtl boundary layer theory, applied to a circular cylinder, is tested experimentally. Assuming that the circumferential velocity of the fluid close to the cylinder is expressible as a power series of the distance from the surface, the coefficients being functions of the distance along the surface, a theoretical step-by-step solution of the boundary layer equation is developed and compared with observations of actual air flow in the layer. It is found that the solution agrees with observation as far round the cylinder as 67°, and by employing a modified method of solution the range of validity is extended up to the point of break-away of the boundary layer (75°). Conditions at this point and the reason for the occurrence of break-away thereat are investigated. All the Prandtl approximations are not valid at the point of break-away. Further advance can only be made by incorporating assumptions in attempting to simplify the equations of viscous fluid motion. J. S. G. T.

**3682. Motion of Viscous Liquids Symmetrical with Regard to the Axis. A. Rosenblatt.** *Comptes Rendus*, 193. *pp.* 139–141, *July* 20, 1931.—It is shown mathematically that the sole motions symmetrical to the axis of a viscous incompressible and irrotational fluid which occur in meridional planes and for which the pressure exercised on the lines of flux is normal to the lines are (1) the whole motion is parallel to the axis of symmetry; potential function is $\Phi = z$; (2) radial motion of a point on the axis of symmetry; potential function is $\Phi = 1/\sqrt{r^2 + z^2}$. [See Abstracts 18 and 274 (1927).] R. S. R.

**3683. Motion of a Plate in an Incompressible Viscous Liquid. A. Rosenblatt.** *Comptes Rendus*, 193. *pp.* 220–222, *July* 27, 1931.—Mathematical treatment of the movement of a plate in a viscous incompressible fluid between walls moving in the opposite direction. H. F. G.

**3684. Wave-Motion and the Equation of Continuity. R. B. Lindsay.** *Nat. Acad. Sci., Proc.* 17. *pp.* 420–426, *July* 15, 1931.—The wave-propagation in a compressible fluid is $\nabla^2\phi = \ddot{\phi}/c^2$, where $\phi$ is the velocity-potential. This is a blend of the continuity equation $\nabla^2\phi = -\dot{s}$, which expresses the essential continuity of the medium, with the equation of motion, $\dot{\phi} = -c^2 s$, written under the approximation appropriate to the small changes assumed. Both these ideas are implied in wave-motion. The author discusses several illustrations of this duality idea. In the propagation of longitudinal waves in a long solid rod, the continuity equation appears in the guise of Hooke's law. The author throws the continuity equation and the equation of motion into the form of a generalised Hamiltonian system. A. D.

**3685. Formation of a Wake Behind an Obstacle with Small Values of Reynolds Number. H. Guillemet.** *Comptes Rendus*, 192. *pp.* 1701–1703, *June* 29, 1931.—For a given value of Reynolds number the distance of the vortex centres from the obstacle is greater for a plate than for a cylinder. The boundary curves of the vortices are, however, of the same form. The types of vortex developed when the motion of the obstacle is non-uniform have been studied. The vortices are formed by the movement of a single film of fluid, whilst the curvilinear triangle of relatively stationary fluid behind the obstacle is fed from the rear. H. F. G.

**3686. Synthetic Turbulence. E. G. Richardson and E. Tyler.** *Phys. Zeits.* 32. *pp.* 509–517, *July* 1, 1931.—This paper contains an experimental study of the origin of turbulence. In the first series of tests a simple finite harmonic disturbance is investigated for a direct air current in a tube, whose wall is capable of movement, and a characteristic laminated disturbance thereby transformed into a characteristic turbulence. In the second series a simple harmonic disturbance is produced at the front of a model which increases the vortex in the keel water. It appears that, in general, turbulence is excited by a finite oscillation which is imposed upon a laminated stream. H. H. Ho.

**3687. Lift on a Flat Plate between Parallel Walls. L. Rosenhead.** *Roy. Soc., Proc.* 132. *pp.* 127–152, *July* 2, 1931.—In this paper the author considers a flat plate between parallel walls since aerofoils are usually used at small angles of incidence for which the corrections of lift for a flat plate and aerofoil are almost identical. Further, it is indicated how the problem of a plate in the neighbourhood of a wall can be solved by taking an appropriate limiting value of the results of the more general problem. To a first approximation the results agree with those obtained by Glauert's theory (see *Elements of Aerofoil and Airscrew Theory*, pp. 177–179). The effect of the walls is to increase the lift coefficient, and curves and tables are given showing this increase for various values of the angle of attack and the ratio of chord of aerofoil to width of channel. The divergence from Sasaki's analysis is noted [see Abstract 11 (1928)], and a brief explanation is given of the reason why the original work is correct for the unbounded jet of air, but not for the bounded stream. H. H. Ho.

**3688. Experimental Investigation of the Diffusion of Liquids. B. Gerlach.** *Ann. d. Physik*, 10. 4. *pp.* 437–459, *July* 21, 1931.—The suspended float method was employed, a number of special floats being constructed of thin walled capillary tubing, a small length at each end of the tube being bent down at right angles and sealed off, so that the float would swim horizontally in suspension when placed in a liquid having a certain density. The positions of these floats in the diffusion cylinder were read off at suitable time intervals, and gave the density and so the concentration at certain points at these times. Very special attention had to be paid to the constancy of the temperature during an experiment. A number of different pairs of liquids were experimented with, all of which except water were organic compounds. The theory of the method is considered in detail, and the method of calculating the diffusion coefficient is described. The values of these coefficients are given for the pairs of liquids experimented with. The values of the molecular radius calculated from these coefficients by means of Stokes' law vary very considerably from the values calculated by means of the kinetic theory of gases as given in Landolt and Börnstein's tables. Results: $CCl_4$ has about the same molecular radius when diffusing into $C_6H_6$ or $C_6H_5NO_2$, and $CH_3OH$ when diffusing into $H_2O$ or $C_6H_5NO_3$; on the other hand the molecular radius calculated from the diffusion of $C_6H_5NO_2$ into $CH_3OH$ is 0·979, and of $C_6H_5NO_2$ into $CCl_4$ 2·03. Similar differences are observed in the case of water diffusing into three different organic compounds. H. N. A.

**3689. Compressibilities of the Permanent Gases. W. Wild.** *Phil. Mag.* 12. *pp.* 41–49, *July*, 1931.—Literature relating to gaseous compressibilities, $1 + \lambda = p_0v_0/p_1v_1$, is briefly and critically reviewed. The following are the most probable values of $1 + \lambda$ for the respective gases at 0° C.:

Hydrogen, $0{\cdot}99939 \pm 0{\cdot}00001$  Nitrogen, $1{\cdot}00044 \pm 0{\cdot}00001$
Oxygen, $1{\cdot}00094 \pm 0{\cdot}000013$  Helium, $0{\cdot}99948 \pm 0{\cdot}000005$
Neon, $0{\cdot}99951 \pm 0{\cdot}000025$  Argon, $1{\cdot}00099 \pm 0{\cdot}000026$.

J. S. G. T.

**3690. Elastostatics of Long, Thin-Walled Tubes. E. Chwalla.** *Akad. Wiss. Wien, Ber.* 140. 2*a*. 3–4. *pp.* 163–198, 1931.—The behaviour of a long, narrow, thin-walled straight tube of circular cross-section is considered under the following conditions: (*a*) when the tube is bent uniformly by terminal couples; (*b*) when it is subjected to axial thrusts; and (*c*) when subjected to an eccentric load acting parallel to the axis. In none of these cases is the relation between load and deflection linear, because of the deformation of the cross-section. In case (*a*) the bending moment M attains a maximum $0 \cdot 378\pi \mathrm{E} r\delta^2$, when the curvature of the axis is $1/\rho = 0 \cdot 806\delta/r^2$. $r$ and $\delta$ are the radius and thickness of the tube, and E is Young's modulus. An increase in the curvature beyond this value causes the tube to collapse. The equilibrium forms of the tube in cases (*b*) and (*c*) are discussed. In both cases, the expression for the equilibrium form is a two-valued function over a certain range, one of its roots representing a labile condition. While the tube is only slightly bent, its equilibrium form is approximately sinusoidal, but departs therefrom very considerably when further loaded. A critical load is finally attained, after which the tube becomes unstable. Approximate and graphical methods are employed throughout. J. P. A.

**3691. Electron Model from the Study of Cracks. T. Terada.** *Imp. Acad. Tokyo, Proc.* 7. *pp.* 215–217, *June*, 1931.—The propagation of cracks in a strained elastic plate and the distribution of strain energy in the plate are closely analogous to the propagation and distribution of associated field energy of electrons travelling in a plane, as visualised by modern statistical theories. The attraction of the electron to a conducting boundary is imitated by the apparent attraction of the apex of the crack towards the edge of the plate. The analogy is discussed briefly. J. P. A.

**3692. Elastic Ring Acted Upon by Equal Radial Forces. C. E. Larard.** *Phil. Mag.* 12. *pp.* 129–143, *July*, 1931.—A thin elastic ring is subjected to (*a*) n equal radial forces P symmetrically arranged; (*b*) n equal forces Q in addition to the P forces, oppositely directed, applied halfway between, and simultaneously with the P forces. The stresses and displacements of all points on the ring are worked out by the method of strain-energy, assuming that all displacements are small compared with the radius of the ring. By making the P and the Q forces separately zero a case of the Maxwell–Rayleigh reciprocal relations is verified. J. P. A.

**3693. Conjugate Points in the Theory of Elasticity. E. Callandreau.** *Comptes Rendus*, 193. *pp.* 218–220, *July* 27, 1931.—This entirely mathematical paper discusses the positions and properties of the three conjugate points introduced by de Fontviolant into the theory of elasticity, in order to give the equations a more symmetrical form. The application of de Fontviolant's ideas to flexure in a plane is chiefly considered.

J. P. A.

**3694. Bending of a Thin Circular Plate. J. J. Vincent.** *Phil. Mag.* 12. *pp.* 185–196, *July*, 1931.—The equations for the displacement of a point in a flat plate bent by normal pressure are solved by successive approximations. The effect of stretching is at first neglected, and the solution thus obtained is employed in the development of second and third approximations which do include the effect. These solutions, which are for the cases of (*a*) a horizontally supported plate, and (*b*) a plate clamped at the circumference, allow of displacements which are not small compared with the thickness of the plate. The results are found to agree fairly well with some experiments of P. T. Steinthal. J. P. A.

**3695. Explosion Waves and Shock Waves. Part I. W. Payman and D. W. Woodhead.** *Roy. Soc., Proc.* 132. *pp.* 200–213, *July* 2, 1931.—This paper deals with the wave-speed camera and its application to the photography of bullets in flight. The Schlieren method used consists essentially of photographing on a film, moving vertically, the horizontal movement of an atmospheric disturbance, using a continuous source of illumination. The extremely short time during which a wave is crossing the field of view necessitates intense illumination, the effective time of exposure being of the order of $10^{-5}$ sec. Full details of the camera are given, and in the photography of bullets in flight the problem at the outset was to synchronise the passage of the bullet with the exposure of the photographic film, since it was not possible to arrange for the direct electrical firing of the cartridges. The present investigation was restricted to a study of the phenomena associated with the emergence of the bullet from a 0·303-in. Service rifle. Direct and Schlieren photographs of tracer bullets, and shadow and Schlieren photographs of ordinary bullets are included with and without obstructions. Sufficient experiments are described to indicate the value of the method in investigations in exterior ballistics. H. H. Ho.

**3696. Dynamics of Bodies of Variable Mass. H. Mineur.** *Comptes Rendus*, 192. *pp.* 1082–1083, *May* 4, 1931.—The motion of *n* small planets in the field of a central body whose mass varies with the time is studied. The eccentricities of the orbits increase with the time and so do the major axes. The latter remain proportional to each other. [See also Abstract 2592 (1931).] G. C. McV.

**3697. Crystal Structure of Cupric Formate Dihydrate. M. Prasad and H. M. Mapara.** *Indian Journ. Phys.* 6. *pp.* 41–49, *June* 15, 1931.—Rotating crystal photographs show the unit cell to have (*a*) 8·952, (*b*) 6·726, (*c*) 8·235 Å., with four asymmetric molecules per cell. Space group $C_{2h}^{5}$. A structure is suggested. C. A. S.

**3698. Crystal Structure of $N_2O_4$. S. B. Hendricks.** *Zeits. f. Physik*, 70. 9–10. *pp.* 699–700, *July* 22, 1931.—The conclusion that solid $NO_2$ cannot possess the molecular formula $N_2O_4$, which is arrived at from X-ray photographs by Vegard [see Abstract 2168 (1931)], is not a necessary conclusion. From the measured equilibrium constants for the reaction $2NO_2 \rightleftarrows N_2O_4$, and from the variation of the light absorption with temperature of a mixture of $NO_2$ and $N_2O_4$ gas, one is forced to conclude that in the solid state the molecule is $N_2O_4$. A complete structure analysis cannot be arrived at from X-ray powder diagrams alone. A probable structure diagram is given which is in agreement with experimental observations. Similar difficulties in the determination of molecular structure in the solid state may be expected to occur in the case of $O_2$. J. E. K.

**3699. Polymorphism of Malonic, Succinic and Glutaric Acids as a Function of the Temperature. F. D. la Tour.** *Comptes Rendus*, 193. *pp.* 180–182, *July* 20, 1931.—Like the monocarboxylic acids [see Abstract 3930 (1930)], certain saturated dibasic acids of the aliphatic series exhibit dimorphism as a function of the temperature. The ordinary triclinic form of malonic acid, obtained by evaporating an aqueous solution, is the $\beta$-variety. Slow cooling of the fused crystals yields the orthorhombic $\alpha$-form, which is stable only above 80° and has the lattice constants:

$a = 8 \cdot 75$, $b = 11 \cdot 6$ and $c = 17 \cdot 1$ Å. The results obtained with succinic acid [see Abstract 1455 (1931)] are now corrected as follows: the so-called $\alpha$- is really the $\beta$-form, and the description of a triclinic form is erroneous. The lattice constants (in Å.) and the refractive indices for sodium light of the two forms are:

| | $a$ | $b$ | $c$ | $n_g$ | $n_p$ |
|---|---|---|---|---|---|
| $\alpha$ .............. | 5·72 | 6·69×4 | 7·59 | 1·597 | 1·513 |
| $\beta$ .............. | 5·06 | 8·81 | 7·57 | 1·605 | 1·497 |

The value $b = 6 \cdot 69 \times 4$ Å. is given, because the strata are very close, but one out of four of them is markedly reinforced; thus the crystal structure along $b$ is almost repeated every 6·69 Å., but the true period of identity is four times this value. Glutaric acid also exhibits this dimorphism; the $\alpha$-form does not appear to be stable at the ordinary temperature and the transition temperature is at about 79°–80°. As with the monocarboxylic acids, so with these dibasic acids, the transition temperatures vary in general in the same way as the melting points. T. H. P.

**3700. X-Ray Investigations of Liquid Crystals. Part III. K. Herrmann and A. H. Krummacher.** *Zeits. f. Physik*, 70. 11–12. *pp.* 758–764, *July* 29, 1931.—This paper continues previous work [see Abstract 2956 (1931)], and contains an experimental X-ray study of anisal 1 : 5 diaminonaphthalene whereby the directivity of the molecules by a magnetic field enables the separation of intramolecular from intermolecular interference. H. H. Ho.

**3701. X-Ray Measurements of Homologous Normal Polymethylene Compounds in Orientated Crystallised Layers. F. Halle.** *Kolloid Zeits.* 56. *pp.* 77–97, *July*, 1931.—A summary and discussion of the results as yet obtained in the X-ray analysis of normal aliphatic paraffins, carboxylic acids and their derivatives, etc. The principal conclusions are as follows: In the crystalline (and, in the main, also in the liquid) form, the molecules of all polymethylene compounds have the form of rods of equal diameters. Their framework consists of a chain of carbon atoms with the diameter 1·54 Å., the centres of these being arranged below the tetrahedron angle in plane extended zigzag configurations so that they lie on two lines parallel to the axis. Similar symmetry is shown by the hydrogen atoms of the methylene groups. The position of, and space occupied by, substituents and end-groups are detectable by X-ray examination, but the packing of the separate atoms of a terminal group cannot yet be determined completely. Owing to their molecular form all polymethylene compounds tend towards a parallel arrangement of the molecules. The crystals belong mostly to the monoclinic prismatic or orthorhombic class, and have leaf-like habit. Asymmetric compounds with active terminal groups have a structure of double molecules associated in pairs. The structure of polymethylene compounds in plane or curved parallel molecular layers on plane or curved surfaces (*e.g.*, drops) exhibits a host of reticulated planes, the distance between which may be readily determined by X-ray measurement. The value of X-ray analysis as an aid in qualitative and quantitative analysis is discussed. T. H. P.

**3702. Spectroscopic Classification of the Elements according to Ground States. C. H. D. Clark.** *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 225–229, *May*, 1931.—The elements are classified according to the fundamental states and the penultimate electron groups. The resulting table separates clearly elements having a penultimate group of 18 electrons from those with a group of 8. Hydrogen is grouped with the alkali metals, and helium apart from the other inert gases with the alkaline earths. The A and B subgroups of the chemical periodic table are clearly differentiated. The A subgroups in the 5th, 6th and 7th main groups are subdivided, and the 8th group is divided into seven sections; the B subgroups are not divided, and contain no incomplete groups of *d* electrons. The fundamental states of the sodium and magnesium subgroups show these to be of the A type, whilst the aluminium and later subgroups are of the B type. H. F. G.

**3703. Valency and Symmetry. P. Vinassa.** *Accad. Lincei, Atti,* 13. *pp.* 642–645, *May* 3, 1931.—Generalises the rules specified in previous work [see Abstract 1447 (1929)]. No chemical compound can have more than one component which is outside the noble or inert symmetry.
E. E. F. d'A.

**3704. Single Electron Bond. J. H. Simons.** *J. Phys. Chem.* 35. *pp.* 2118–2124, *July,* 1931.—The various theories connected with the single electron bond are critically examined and discussed. The use of the single electron bond to assign a structure to higher valency compounds, chelate organic compounds, molecular compounds or double salts is considered with reference to a molecular compound $SnCl_4(POCl_3)_2$. It is concluded that the assumption of the single electron bond as a valency connection is not only unnecessary to account for chemical properties, but it leads to properties which are contrary to fact. F. J. B.

**3705. Structure of the Molecule-Linking in Veramon. E. Hertel.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 267–272, 1931.—A molecular compound is defined as a substance, which is composed of molecules of two different kinds in stoichiometric proportions, possesses its own crystal lattice independent of those of its components, and, in solution or on evaporation, decomposes into the components in accordance with the law of mass action. Veramon is found to consist of veronal and pyramidone in the stoichiometric proportions 1 : 1 and is a true molecular compound in the light of the above definition. T. H. P.

**3706. Calculation of Atomic Characteristic Frequencies. A. Magnus.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 273–282, 1931.—Starting from simple mechanical concepts, a formula for the characteristic frequency $\nu$ in solids is developed. If the coordination number is $p$, then the general expression is $\nu = (1/2\pi)\sqrt{-pf''(r_0)/3\mu}$, where $f''$ means the second derivative of the binding energy, and $r_0$ the equilibrium atomic distance, for the mass $\mu$. Substitution of measurable quantities gives $\nu = (1/2\pi)\sqrt{6v_M/Mr_0^2\chi}$ for a binary compound. Here $v_M$ is the atomic volume, M the "reduced mass" and $\chi$ the compressibility. No arbitrary constants are involved. Good agreement with experiment is found for NaCl, KCl, KBr and MgO. The possible influence of Schottky's statistical correction is discussed for doubtful cases. F. I. G. R.

**3707. Atomic Weight of Iodine. O. Hönigschmid and H. Striebel.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 283–290, 1931.—Silver iodide was prepared by direct synthesis of metallic silver and pure iodine, and a weighed quantity was converted into the chloride by heating it in a current of chlorine. The ratio between the molecular weights of

AgI and AgCl was found to be 1·638076. Taking the atomic weights Ag = 107·880 and Cl = 35·457, based on O = 16·0000, this gives the atomic weight of iodine as 126·917. Aston has found I = 126·932 in relation to the oxygen isotope $O^{16} = 16$, and the atomic weight in relation to ordinary oxygen calculated from this will be 1/10,000 less, or about 126·918. It appears then that the authors' value is more probable than the present international chemical value, which is 126·932. H. N. A.

**3708. Kinetics of the Union of Hydrogen Atoms in Triple Collisions. W. Steiner and F. W. Wicke.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 817–830, 1931.—Hydrogen atoms were produced in a discharge tube, and passed into a reaction tube in which the concentration of atoms was measured at as many places as possible along the length of the tube. Action of the walls of the tube on the atomic hydrogen at the low pressures employed was prevented by a special cleaning process, including a treatment by an electrical discharge through it, with 10 to 15 % addition of water vapour. The atomic concentration was measured by means of the spectroscopic method of Bay and Steiner. The intensity of $H_\alpha$ was determined in photographs of the spectrum at different points. In this way the ratio between the concentrations was obtained. The actual concentration at one point in the tube was obtained by means of Wrede's diffusion slit. Experiments were carried out at pressures from 0·3 to 0·7 mm., and at atomic concentrations from 80 to 15 %. The velocity constant was found to be $9 \cdot 10^{15}$ cm.$^{-3}$ sec.$^{-1}$. Triple collision with a molecule as third partner was found to be more active than with a third atom. H. N. A.

**3709. Action of Atomic on Molecular Hydrogen. K. H. Geib and P. Harteck.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 849–862, 1931.—Describes apparatus with which the action of H atoms on parahydrogen has been studied. The parahydrogen is converted into normal hydrogen $H_2$(para) + H = H + $H_2$(normal). Farkas found that the same reaction accounts for the thermal change from para- to normal hydrogen. Ordinary hydrogen was partially converted into parahydrogen by passing it through a bulb filled with pieces of adsorption carbon, which was cooled by liquid air or liquid hydrogen. It passed into a reaction chamber, where it mixed with atomic hydrogen produced in a Wood's discharge tube. The mixture of para- and normal hydrogen formed was analysed by measuring its thermal conductivity. From the relation between the reaction and the temperature the heat of activation was found to be 7250 ± 250 cal. The collision yield of the reaction at 10° C. amounts to 1/3,000,000, and the steric factor is 1/8. The destruction of parahydrogen was shown to be a suitable indicator for small concentrations of atomic hydrogen. Certain photochemical experiments are communicated, in which the concentration of atomic hydrogen was found by this method. H. N. A.

**3710. Exchange Energy. P. Starodubrowsky.** *Zeits. f. Physik,* 70. 11–12. *pp.* 812–816, *July* 29, 1931.—Calls attention to the work of Heitler and London, who, making use of quantum mechanics, have investigated the question of the energy of reciprocal action of two hydrogen atoms combining to form a molecule. The author investigates the case of a heterogeneous molecule formed of two unequal atoms, and finds that as the ratio between the nuclear charges increases the exchange energy diminishes, so that the energy of reciprocal action depends to only the smallest extent on the exchange effect. H. N. A.

**3711. Molecular Rays. W. H. Rodebush.** *Rev. Modern Physics*, 3. *pp.* 392–411, *July*, 1931.—This is an interesting summary and commentary on the work done on this subject during the last twenty years, with references to 49 original papers and some account of the most recent investigations and of work now in progress, concluding with a note on the possible uses for molecular rays. It has been recognised for a long time that peculiar effects are to be expected in gases at very low pressures where the mean free path is large compared to the dimensions of the containing vessel. These effects occur in the evaporation of metallic atoms from hot filaments where, if an object is placed between the filament and the wall, no metallic deposit is produced on the part of the wall that is in the " shadow " of the object. After the introduction, in which reference is made to the work of Ellett and Johnson on the reflection of molecular beams from crystals, the present paper treats of the theory of molecular rays, the effective pressure in the beam, the effect of tube slits and multiple slits in dealing with the usual method of formation of molecular rays by the escape of gas molecules at low pressure through a sequence of slits. The distribution of velocities in a beam, some details of slit construction, and the detection of beams are also considered. The now classical experiment of Stern and Gerlach on the deflection of a beam of silver atoms in an inhomogeneous magnetic field is dealt with theoretically and practically, and the relations between this effect and the spectroscopic term of the atom are considered. The magnetic moment of the free electron, the Stern–Gerlach experiments on molecules, nuclear moments, polar molecules in an inhomogeneous electrostatic field and the diffraction of molecular rays by crystals with consideration of de Broglie waves are dealt with in successive sections, and in conclusion reference is made to one of the most interesting recent applications of molecular rays—that of the study of molecular association. The mean life of excited states of atoms or molecules is often too short to permit the Stern–Gerlach experiment to be performed, but such an experiment is at present being attempted by L. A. Murray in Illinois. The most promising application of molecular rays appears to be the study of gaseous chemical reactions. J. J. S.

**3712. Application of Spinor Analysis to the Maxwell and Dirac Equations. O. Laporte and G. E. Uhlenbeck.** *Phys. Rev.* 37. *pp.* 1380–1397, *June* 1, 1931.—By extending the spinor analysis developed by B. van der Waerden by introducing three self-dual tensors, the authors show that many spinor equations become simpler than the corresponding tensorial equations, especially the expression for the stress energy tensor. The Maxwell and Dirac equations are derived from a spinorial variation principle, analogous to the results of Gordon and Darwin. In addition to the divergence condition for the current three new invariant relations are obtained between the wave functions which are independent of the potentials. H. L. B.

**3713. Tensor of Dirac's Equation. B. Podolsky.** *Phys. Rev.* 37. *pp.* 1398–1405, *June* 1, 1931.—A simple tensor form of Dirac's equation is obtained. It is shown that the introduction of the idea of half-vectors in quantum mechanics, while undoubtedly desirable when dealing exclusively with Cartesian coordinates, is unnecessary. H. L. B.

**3714. Quantum Dynamics of Electrons. E. Schrödinger.** *Preuss. Akad. Wiss. Berlin, Ber.* 3. *pp.* 63–72, 1931.—The Dirac wave equation of the electron gives a much too high probability for the transition of electrons from a positive to a negative mass. An alteration of Dirac's equation is given which is free from this difficulty, but provides unaltered term values in agreement with experiment. H. L. B.

**3715. Undulatory Theory of Matter. P. Pagnini.** *Pont. Accad. Sci., N. Lincei, Mem.* 15. *pp.* 259–290, 1931.—One of a series of papers devoted to a close and critical examination of the hypotheses assumed as the foundation of the undulatory theory of matter. The conclusion is stated that the purely undulatory theory is competent to explain the kinematical relations, but not the dynamical, the data for which are found to be left indeterminate. A. D.

**3716. Possibility of Transformation of Radiant Energy into Matter. F. G. Donnan.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 131–134, 1931.—Making use of the ideas of Jeans and Milne with regard to the thermodynamic equilibrium between proton and electron and radiative energy, and assuming that $cT/\nu = 0{\cdot}29$, with $\nu = 2{\cdot}2{\cdot}10^{23}$, the author finds that the temperature of a hollow space in which the active equilibrium, proton + electron $\rightleftarrows$ radiant energy or photon, is to be expected is $T = 0{\cdot}3\nu/c = 2{\cdot}2{\cdot}10^{12}$. The author suggests that the formation of protons and electrons may also be possible from photons of sufficiently high frequency in cold spaces, when the density is great enough, and could be regarded as a photochemical reaction. H. N. A.

**3717. Two Examples of Heisenberg's Uncertainty Relation for Bound Particles. B. Remak.** *Zeits. f. Physik,* 69. 5–6. *pp.* 332–345, *May* 12, 1931.—The appearance of quantum numbers in Heisenberg's uncertainty relation for bound particles is verified for the cases of the harmonic oscillator and the Kepler problem. H. L. B.

**3718. Various Statistics and Their Formulæ. S. Suzuki.** *Zeits. f. Physik,* 70. 1–2. *pp.* 140–144, *June* 20, 1931.—In order to make clear the relation between the old and the new statistics various forms of a formula, which is satisfied by all statistics, are deduced. From this follows the possibility of the existence of many other forms of statistics; as an example, the generalised form of the Fermi-Dirac statistics is obtained by the polynomial method from this formula. This is very closely connected with the requirement that an upper limit for energy-density exists. Both statistics give the same form for the light-quantum and only deviate from one another for gases. [See also Abstract 4062 (1930).] H. L. B.

**3719. Collision Between Two Particles Considering the Retardation of the Forces. C. Møller.** *Zeits. f. Physik,* 70. 11–12. *pp.* 786–795, *July* 29, 1931.—Relativistic, invariant expressions for the scattering of very fast particles have been deduced by means of a suitable generalisation of Born's collision theory. In this way the effective sectional area for the collision of two free electrons has been calculated, and the result is compared with previous treatments of the same problem. When the relative velocity is very large the theory indicates a different equation from that which holds for smaller velocities. Such very large velocities have not as yet been produced artificially, as 100 million volts would be required. Such velocities, however, are probably to be found in the electrons which cause the aurora borealis, and in those which accompany the high-altitude Hess radiation. H. N. A.

**3720. Wave-Functions of Many-Electron Atoms. J. E. Lennard-Jones.** *Cambridge Phil. Soc., Proc.* 27. *pp.* 469–480, *July* 31, 1931.—A method of solution of the equations of the many-electron atom which were first proposed by Hartree and further developed by Fock by the introduction of the " exchange effect " terms, is worked out by using the spin coordinates as well as the space coordinates. This method of solution is shorter and more elegant than previous ones which have been given. The paper is entirely mathematical. G. C. McV.

**3721. Wave Particles as Transmitted Possibilities: Quantum Postulates Derived from Logical Relativity. W. Band.** *Phys. Rev.* 37. *pp.* 1164–1170, *May* 1, 1931.—After criticising general relativity, the author sets up a new fundamental hypothesis which leads to a new definition of photons, electrons and energy. The meaning of the existence of a " particle " in the new theory and the way in which an indeterminacy in the situation of a particle arises, are discussed. H. L. B.

**3722. Unified Field Theory. P. Straneo.** *Accad. Lincei, Atti,* 13. *pp.* 364–370, *March* 1; 695–701, *May* 3, *and pp.* 770–774, *May* 17, 1931. *Comptes Rendus,* 192. *pp.* 1364–1367, *June* 1, 1931.—Field equations of gravitation and electromagnetism are derived by the use of an asymmetric connection in the four-dimensional manifold and an *a priori* assumption of the existence of an energy tensor. G. C. McV.

**3723. General Field Equations. B. Lagunoff.** *Zeits. f. Physik,* 69. 9–10. *pp.* 699–700, *June* 8, 1931.—A list of the field-equations of a field containing matter and electricity already obtained [see Abstract 1003 (1931)] with some divergence-relations deduced from them. G. C. McV.

**3724. Two-Particle System and Gravitation. J. le Roux.** *Comptes Rendus,* 192. *pp.* 1309–1311, *May* 26, 1931.—Following up his previous paper [see Abstract 2926 (1931)], the author shows the impossibility of formulating a law of gravitation for a system consisting of two mobiles assimilable to two material points. In such a system there is only one invariant, and there is nothing to fix the system of reference and the time. If we attempt to work out a law of gravitation, we reach meaningless results. For three or more particles a law is possible. A. D.

**3725. Cyclic Universe. T. Takéuchi.** *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 166–177, *June,* 1931. *In English.*—The properties of a spherical universe whose radius is proportional to the function $e^{\sin kt}$ ($k$ is a constant; $t$, the time) are studied. There is an apparent " velocity of recession " for distant objects and the value of $k$ can be determined from it. $k$ can also be determined by an estimation of the rate at which matter is turning into radiation at the present moment in the universe, and it is stated that the two values of $k$ thus obtained are the same. At the time of least expansion the universe is full of matter, but there is no radiation; at maximum expansion the opposite is the case. The total energy of the universe is constant throughout all time. A particle which has no velocity is not subjected to an acceleration, whether it is at the origin or not. The paper concludes with a calculation of the amount of radiation that would be received, by an observer at the origin, from the rest of the universe. G. C. McV.

## METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

**3726. Rain-Gauge Funnels of Different Depths. J. Glasspoole.** *Monthly Weather Rev.* 59. *pp.* 157–158, *April*, 1931.—The advantages of the Snowdon type of rain gauge over other patterns with a shallow funnel are discussed. The former has much smaller errors due to outsplashing of the rain and is much more reliable for measurements of snowfall. R. S. R.

**3727. Rainfall Distribution in Homogeneous Air Currents and at Surfaces of Discontinuity. A. H. R. Goldie.** *Meteorological Office, Geophys. Mem.* 6. *No.* 53. [19 *pp.*], 1931.—The author deals principally with rainfall recorded at British observatories during 1922–1924 on days classified as (1) warm front, (2) cold front, (3) polar air and (4) equatorial air. For these days the average amount and diurnal variation of the rainfall was determined. According to this classification it was found that for (1) the diurnal variation of rainfall changes from place to place while the amount depends largely on orography; (2) the semidiurnal variation is the most pronounced feature, but the variation in amount with locality is considerable; (3) the total rainfall is small, while the diurnal variation is not characteristic in winter but shows a maximum at 15–16 hours, and a secondary maximum in the early morning hours, in summer; (4) the total rainfall varies considerably owing to orography, while the diurnal variation is shown in winter and summer. The times of maxima correspond roughly to those of minima of pressure and *vice versa*. The diurnal variation of rainfall at fronts is considered to be controlled primarily by (1) the thermodynamical action of insolation and radiation on the more or less clear warm sector in advance of the front for cold front rainfall, and (2) the corresponding effects of insolation and radiation on the cloudy warm air above the upsliding surface for warm front rainfall. The relationships with wind speed, pressure and pressure changes are also discussed. R. S. R.

**3728. Relationship between Fog and Relative Humidity. W. H. Pick.** *Roy. Meteorolog. Soc., J.* 57. *pp.* 288–291; *Disc.*, 292–295, *July*, 1931.—Observations of fog (visibility below 1100 yds.) and thick fog (visibility below 220 yds.) at Cardington at 07, 10, 13, 16, 18 and 21 hours G.M.T. for the years 1929 and 1930 are analysed according to the accompanying relative humidity obtained from a wet and dry bulb hygrometer. The results show that the majority of all fogs at an inland rural site occur with a relative humidity $< 100\%$. Other data in support of this view were given in the *Discussion*, while the view was expressed that the air in the interstices between the fog particles was not saturated. R. S. R.

**3729. Aspirating Shafts at Caux. Caulle and Idrac.** *Comptes Rendus*, 193. *pp.* 70–72, *July* 6, 1931.—Registrations of temperature, pressure, humidity and wind speed and direction at the top and bottom of a shaft over a period of several months showed that air flowed up the shaft with falling atmospheric pressure, and *vice versa*. The phenomenon is due to the porosity of the chalk at the bottom of the shaft, and in the case examined the air flow indicated that a volume of $6 \times 10^6$ cu. m. of ground took part in the action. The effect is used locally as a weather portent, the chalk serving as a very sensitive barograph. R. S. R.

**3730. Present Position of Weather Forecasting. C. K. M. Douglas.** *Roy. Meteorolog. Soc., J.* 57. *pp.* 245–253, *July*, 1931.—The author reviews ideas regarding the growth and movement of depressions and anticyclones, frontal analysis of existing weather situations and the use of this method in forecasting, the relation of non-orographic rain to fronts and the complexity of this problem, the forecasting of showers and thunderstorms and the persistence of weather types. R. S. R.

**3731. Employment of the Projected Factor of Turbidity. F. Lauscher.** *Gerlands Beitr. z. Geophys.* 30. 1–2. *pp.* 136–141, 1931.—The conception of the projected factor of turbidity due to Feussner and Dubois is elaborated through the idea of the " projected intensity of radiation." This is obtained if the whole optical turbidity extending for the time being over a given level is considered as extended at the same altitude of the sun over the whole atmosphere down to sea-level. Thus there is formed, as it were, an absolute measure of turbidity independent of height above sea-level. The use of this turbidity factor is illustrated by a table connecting the values of the sun's altitude and the turbidity factor with the intensity of the sun's radiation, so that taking the value of the factor at a certain place at a given time and observing the corresponding sun's altitude, the radiation intensity is at once found in the table. J. J. S.

**3732. Symmetry Domains of Air Pressure. K. Lehmann.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 241–276, 1931.—Weickmann's theory that there are certain dates on which the pressure curve for a succeeding period is the mirror image of that for an equal preceding period is further examined as regards periods of 72 days around 15/1/24 and 15/12/24 (the symmetry days for Hamburg as symmetry centre) by consideration of the first nine sine components obtained by harmonic analysis of the pressure curves at numerous stations. The correlation coefficients for times equidistant from the symmetry days are plotted geographically for all or some of the components, and domains of greater and less symmetry thus determined. These are discussed with the aid of numerous charts and curves, and with reference to waves of various periods, in particular of 24 and 36 days. It is considered that the symmetry domains for the two winters although of very different character, show satisfactory constancy. The possible application of the theory to long period forecasting is mooted. C. A. S.

**3733. Periodic Oscillations in Natural Phenomena. W. B. Schostakowitsch.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 281–335, 1931.—Periodicities in general are treated first. Changes in solar activity as indicated by sunspot maxima and minima are then compared with geophysical, biological, economic and social cyclical changes. The dependence of these several processes on the climatological changes produced directly by changes in solar activity are examined. From general considerations of ultimate causes for these cycles, the possible action of cosmic or planetary changes is discussed. R. S. R.

**3734. Polarisation of Light from the Sky and its Connection with Other Meteorological Elements. W. Smosarski.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 408–424, 1931.—The annual variation of the polarisation of the diffuse light from a cloudless sky at noon and sunset was obtained with a Cornu photopolarimeter for just over three years. The polarisation is resolved into three components at right angles and the relations between its changes and simultaneous values of the intensity of solar radiation, aqueous vapour pressure, temperature, atmospheric pressure, wind direction and speed, electrical potential gradient and conductivity of the air are examined. The turbidity of the atmosphere appears to be the main factor and the others secondary. The relations appear to depend upon the season of the year and the degree of polarisation. [See Abstract 386 (1931).] R. S. R.

**3735. Ozone Content of the Atmosphere. R. Mecke.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 392–404, 1931.—In order to obtain information concerning the ozone content of the atmosphere, the photochemical equilibrium $O_3/O_2$ has been investigated using the available spectroscopic data. An equation has been developed giving the concentration of ozone as a function of the air pressure and it is calculated that at a height of 50 km. the concentration of ozone is about $2 \times 10^{-4}$ compared with about $10^{-8}$ at the earth's surface. F. J. W.

**3736. Structure of the Earth's Atmosphere. H. G. Smith.** *Roy. Astron. Soc., Canada, Trans.* 25. *pp.* 238–256, *July–Aug.*, 1931.—A summary is given of the main facts regarding the composition and exploration of the atmosphere and the variation of temperature, wind and water vapour with height. R. S. R.

**3737. Influence of the Anisotropy of the Earth's Rock Crust on the Distribution of Low-Period Magnetic Alternating Fields. M. Müller.** *Gerlands Beitr. z. Geophys.* 30. 1–2. *pp.* 142–195, 1931.—The Faraday–Maxwell theory distinguishes between stationary and quasi-stationary fields and the electrodynamic processes to which the electromagnetic waves belong. Hitherto the fields mentioned have been almost exclusively of practical signification for the electrical examination of the earth's surface whilst electrodynamic methods played a very subordinate rôle. Referring to Schlumberger's method of localising good-conducting disturbing bodies by means of stationary electric fields, and mentioning its practical disadvantage that the magnetic field of stationary currents could not be measured with technical accuracy, the author proceeds to give an account of the early use of quasi-stationary fields in which an a.c. generator of 500 periods as source of current and a telephone as indication instrument were used and then describes the use of sine-form a.c. by Hecker and the methods of Abrahams. The paper is a long one and is illustrated by 50 figures, including photographs and diagrams of apparatus and curves showing the results obtained. The following is a summary of the contents of the paper. (1) Introduction and statement of the objects of the research. (2) Apparatus for the production and measurement of small period electromagnetic alternating fields of any low frequency. (3) Calculation of the current field of an electric dipole in connection with frequency, conductivity and thickness of strata. Setting forth of the conditions for the disappearance of the source-free secondary current. (4) The influence of the anisotropy of the rocky crust on the distribution of stationary currents. (5) Graphic calculation of the magnetic field of a double source with consideration of the decrease of the current density with depth. (6) Electromagnetic field measurements by means of the directly conducted current of the earth: (*a*) experimental research on the influence of frequency and anisotropy on the distribution of the components of the magnetic field of a double source; exposition of a new method for the determination of the mean conductivity of the earth; (*b*) investigation of a series of strata by means of l.f. a.c.; (*c*) measurement of a deposit of Thuringian magnetite by means of l.f. a.c.; (*d*) a similar investigation of a deposit of baryta-pyrites. (7) Theory of the inductive method: (*a*) calculation of the magnetic field of a stationary current circuit; (*b*) investigation of the rotatory currents induced in the earth's crust by a closed alternating current; (*c*) consequences of the theories of Levi-Civita and Pollaczek. (8) Inductive field measurements of a.c. of various frequency: (*a*) investigation of the dependence on frequency of the distribution of the magnetic field of a right-angled cable traversed by an alternating current; discussion of the influence of anisotropy on the Jena Mussel-chalk; (*b*) investigation of a series of strata by means of a low-period electromagnetic alternating field; (*c*) investigation of the magnetic external field of a small period current circuit upon anisotropic rock structures. J. J. S.

**3738. Calculation of Deformed Electromagnetic Fields in Geoelectric Prospecting. A. Belluigi.** *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 4. *pp.* 363–372, 1931.—This subject, of great practical interest, has been dealt with little, if at all, in the special literature of the day. Hitherto the author has been concerned with examining the behaviour of the electromagnetic field of a current for some bodies of simple geometrical form. In the present paper consideration is given to the calculation for a body of any form whatever which is situated in the field of force of a current dipole. The dipole lies horizontally upon a half sphere of infinite extent. The author attacks the problem in the following way: (1) Calculation is made of the bundle of tubes of force so that its quantitative distribution in an infinite half-sphere is known, and also a determination is made of those current strengths which are influenced by an electrically anomalous body immersed in a homogeneous earth according to its position, state and electric character. (2) Then a calculation is made of the maximum deformation of the field in which the body concerned is regarded as a sphere, and thus is obtained the strength of current which the anomalous electric field produces at the earth's surface. (3) Next the author proceeds to the determination of this magnetic field at the surface of the earth with suitable extension of the Biot–Savart law, with the help of a new graphical process. J. J. S.

**3739. Use of H.F. Electromagnetic Waves for Localisation of Underground Formations. W. Stern.** *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 4. *pp.* 437–456, 1931.—Investigation was made as to the applicability of e.m. waves of high frequency ($N = 1 - 3 \times 10^7$ hertz) for the detection and localising of dishomogeneities of the conductivity of underground strata in moist mountain districts. It is shown how the extension and structure of formations can be determined by measuring the direction and amplitude of electromagnetic waves of sufficiently high frequency. By reflections the existence of strata differing in their conductivities or dielectric constants from the surrounding rocks can be discovered. Methods of mathematical calculation for determining their depth are developed for typical cases. A detailed description of the apparatus required, consisting of transmitter and receiver, is given. For measurement of the greatest attainable depth the absorption coefficient of the rock as function of the frequency employed was used in the case of brown coal, and from the data obtained values were found by extrapolation for other materials with reference to their specific resistivities. The lowest depth of the stratum, prospected for whence the waves were reflected, was found to be $> 2\lambda$ of the wave-length employed. A beam-sending transmitter with circular frame as aerial is described. T. J. S.

**3740. Formation of Love Waves in a Two-Layer Crust. H. Jeffreys.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 336–350, 1931. *In English.*—The generation of SH and Love waves (*Querwellen*) from an impulsive source is considered. A quasi-symmetrical pulse of the SH type is generated by the sudden application (or removal) of rotational stress over a sphere within the upper layer of the crust and the effect of the lower layer on the subsequent motion is required. The analysis is very similar to that used formerly for compressional waves in two superposed layers, but it is carried further [see Abstract 320 (1927)]. It is found that the disturbance transmitted through the lower layer consists of overlapping pulses each starting at an instant corresponding to the time of transmission of a pulse that has undergone an integral number of reflections in the upper layer. The recovery after each pulse leads to a train of waves, the superposition of which gives the Love waves. R. S. R.

**3741. Form of Seismograms and Processes in the Region of the Foci. G. Krumbach.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 351–365, 1931.—In the case of the Kamchatka earthquake it is shown that for certain epicentral regions even within large time intervals and large areas quite definite characteristic forms of the seismograms occur. To obtain an explanation of the phenomenon the influence of events in the epicentral region such as explosive, intrusion, crystallisation and radioactive processes and of the focal depth on the form of the seismograms is treated and the author seeks to connect these results with the formation of earthquakes. R. S. R.

**3742. Surface Waves. Part I. T. Itoo.** *Gerlands Beitr. z. Geophys.* 30. 3–4. *pp.* 366–407, 1931.—After deriving the boundary conditions for visco-elastic media, the properties of Rayleigh and Love waves are found in these media. In general the properties are the same as for elastic media except for damping. The amplitude decreases with time while the period decreases as if friction were acting, the damping coefficient depending partly on the period. The surface particles describe elliptic spirals instead of the ellipses for elastic media, but the plane of their motion is unaffected by damping. When the surface oscillates, and Rayleigh waves occur, other waves are formed which penetrate into the earth with unchanged amplitude. For shearing waves at an interface, wave form and viscosity are more important for short than for long waves. Under favourable circumstances, as when the velocity of the shearing waves is the same in superposed layers, another wave is formed by derivation from the Rayleigh waves with a velocity between that for the Rayleigh and the simple shearing waves. The procedure has been extended to find the wave form and strain for three or more superposed layers. In some cases at the onset of the surface waves both strain and displacement increase with depth and the elastic limits are exceeded, a new focus for secondary earthquakes being formed. R. S. R.

**3743. Empirical Investigation of Surface Waves Generated by Distant Earthquakes. L. D. Leet.** *Dominion Obs. Ottawa, Publ.* 7. 6. *pp.* 267–322, 1931.—The surface waves generated by 127 earthquakes that occurred during 1922–29, as recorded by similar Milne-Shaw instruments (122 at Ottawa recorded under identical conditions, 4 at Harvard, and 1 at Rio de Janeiro) are examined, and true earth amplitudes determined for 18. The earth particle during the passage of a Rayleigh (R) wave rotates retrogradely in an elliptical path relatively to the direction of propagation, as required by theory. There is a definite correlation between the velocities of such waves, and the direction whence they come, those coming from across the Atlantic being highest. The records of horizontal component seismographs depend on the orientation of the instrument relatively to direction of propagation, especially in the case of " maximum " (M) waves. Earthquakes from the same epicentre in some cases give almost identically similar records, but it is doubtful how far this is merely due to identity of distance and orientation of the seismograph relatively to the direction of the disturbance. C. A. S.

**3744. Transmission of Seismic Waves on the Bottom Surface of an Ocean. K. Sezawa.** *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 115–143, *June*, 1931. *In English.*—The author has determined by mathematical analysis the effect of ocean water upon the 2-dimensional transmission of Rayleigh-type waves on the bottom of the ocean and especially the nature of the dispersion of an arbitrary wave progressing outwards from an epicentre. He finds that the viscosity of the water has no influence on the transmission of these waves, but its pressure in the sense of forming surface water waves is of great importance. Its compressibility affects only the motion of the superposed water. The velocity of the harmonic wave increases with the wave-length, but there is no definite critical velocity for harmonic waves of infinite extent. For 2-dimensional transmission of the waves the vertical displacement of solid and water decreases with epicentral distance. For the long waves the ratio horizontal/vertical component exceeds that for ordinary Rayleigh waves, but for short waves it is smaller. The motion of the water particle is mainly vertical. However concentrated the original disturbance, dispersion of the waves increases with epicentral distance more and more. For the dispersed waves the leading part has (1) velocity the same as for Rayleigh waves, (2) phase changing with distance, (3) increasing wave-length and (4) decreasing amplitude. The group velocities depend on the harmonic components involved, while the phase velocity also varies. If the effects of gravity and water are omitted, the transmitted waves for a concentrated disturbance are of a subsiding type without oscillation.
R. S. R.

**3745. Acceleration in Earthquakes. M. Ishimoto.** *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 159–167, *June*, 1931. *In French.*—The principle of the instrument used is that previously described [see Abstract 8 (1928)]. A horizontal copper cylinder, 3·2 kg. in weight, is supported on two vertical blades attached along a generatrix so that its period of vibration is about 0·1 sec. Projecting horizontally and perpendicular thereto from the middle of the cylindrical side is an aluminium arm supporting a horizontal rod perpendicular to the arm, with means for controlling and damping its movements, which are registered optically. An amplification of about 1700 with a displacement of about 1 cm. for an acceleration of 2·7 gal. is obtained. The records of 24 shocks at Tokyo between July and October 1930 are discussed preliminarily. C. A. S.

**3746. Reflected Waves from Deep Focus Earthquakes. F. J. Scrase.** *Roy. Soc., Proc.* 132. *pp.* 213–235, *July* 2, 1931.—The effect of an abnormally deep focus on the reflected waves of earthquakes is considered. In general a number of supplementary reflected waves may occur and if the focus is sufficiently deep the separate phases are shown on the records at appreciable intervals after the direct phase. The appearance of these waves provides a means of recognising deep focus earthquakes from records at a single station. The times of travel of supplementary and more normal waves are derived for several depths of focus, Knott's paths of longitudinal and transverse waves being taken as the basis. Using seismograms for Kew and Eskdalemuir, the commencement of additional phases are generally recognised, while the times of transit are in reasonable agreement with calculation, thus confirming the occurrence of deep focus earthquakes. The focal depths are roughly the same as those given by Turner. The results favour the idea that the initial phase of an earthquake is a direct compressional wave and is not generated by reflection of a distortional wave. R. S. R.

**3747. Horizontal Diameter of the Sun in 1929 and 1930. G. Armellini.** *Accad. Lincei, Atti,* 13. *pp.* 635–638, *May* 3, 1931.—These measurements were begun at Campidoglio in 1876 by Respighi and have been continued ever since without interruption or change of method. The sun's image, nearly a metre in diameter, is projected on a screen and observed with the transit instrument at noon on every clear day, the times of transit of each limb across the seven micrometer wires being noted by the eye and ear method simultaneously by four observers, with the aid of a Dent chronometer. The results for the last few years show a marked minimum of $960''\cdot 63$ at the beginning of 1925, and since then the solar radius has gradually increased, reaching in 1930 the value of $961''\cdot 68$. Probably a decline has now set in. These more or less periodical fluctuations must be due to the fact that the energy produced in the sun is not always perfectly equal to the energy radiated, in agreement with modern stellar theory. To investigate this question pyrheliometer observations have been carried out daily since June 1929, and the results will be given in a later paper. M. A. E.

**3748. Height of Chromosphere in 1930. G. Abetti.** *Accad. Lincei, Atti,* 13. *pp.* 639–640, *May* 3, 1931.—Observations of the chromosphere have been made at Arcetri and Madrid by measuring the height of reversed H$\alpha$, with slit radial to the sun's limb. Arcetri observations on 67 days in 1930 show a slight diminution, the mean for the year being $10''\cdot 28$ while the mean in 1929 was $10''\cdot 38$, and a fall was also observed at Madrid and at Catania. The heights are almost the same at all solar latitudes, but have a tendency to rise slightly at the poles. The total area of prominences, which diminished by 156 units between 1928 and 1929, diminished in 1930 by 291 units. The relative numbers of sunspots, according to international observations received and reduced at Zürich, fell from 65·0 in 1929 to 35·7 in 1930, so that the present cycle, which began in 1923, is doubtless not far from the minimum. M. A. E.

**3749. Distribution of Flattening in Elliptical Nebulæ. A. Machiels.** *Bull. Astronomique,* 6. *pp.* 317–324, 1930.—Hubble in 1926 divided 87 elliptical nebulæ into eight classes according to the degree of apparent flattening, and deduced the probable real flattening by a method which eliminated the effect of orientation in the line of sight. The nebulæ, when re-classified according to real flattening, increased fairly regularly in frequency with increased flattening, except in the first and last classes. An improved method, based upon a more natural way of defining these two classes, gives a closer correlation, and thus supports the theory of continuous nebular evolution. M. A. E.

**3750. Jupiter's Galilean Satellites. W. de Sitter.** *Roy. Astron. Soc., M.N.* 91. *pp.* 706–738, *May,* 1931. *Observatory.* 54. *pp.* 205–212, *Aug.,* 1931. *George Darwin Lecture.*—The satellites of Jupiter have, ever since their discovery, played an important part in the development of astronomy, expecially in the study of secular and long periodic perturbations, because they resemble the sun's planetary system, but on so small a scale that the 321 years during which they have been known to us are equivalent, in the number of revolutions round their primary, to nearly 18,000 years of the four inner planets. After a brief historical account, the lecturer explained the advantages of his new mathematical theory. The only two points on which the representation of the observations by the theory is not entirely satisfactory are: (1) the contradiction between the results from ancient and modern observations of the equation of centre of Satellite III, which can only be settled by observations continued for another half-century, and (2) the large residuals in longitude at some epochs of all the satellites, for which it will be necessary to observe them as discs instead of points of light with a heliometer of great focal length. The elements of these satellites are now far more accurately known than those of the inner planets were known before the invention of the telescope, and this is because we have had the powerful help of the mathematical theory. M. A. E.

**3751. Orbits of Comets and the Planet Pluto. G. Fayet.** *Comptes Rendus,* 192. *pp.* 1362–1364, *June* 1, 1931.—The orbits of all comets appearing between the years 1680 and 1930 were examined and it was found that one comet out of some 240 considered effectively approached Pluto during 1920. G. C. McV.

**3752. Determination of Colour Index from Effective Wave-Lengths. V. Oberguggenberger.** *Akad. Wiss. Wien, Ber.* 140. 2*a.* 3–4. *pp.* 141–161, 1931.—The disadvantages and uncertainties which beset this extremely valuable method of deducing colour index from measurements of stellar spectra can be overcome to a great extent. A series of plates has been taken with a view to discovering the influence of temperature, zenith distance of the star, kind of plate used, choice of comparison stars, etc. If more time and trouble are given, in the ways indicated, when making the observations, the method will be found satisfactory. M. A. E.

**3753. Upper Limits for Stellar Masses. F. Tyler.** *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 221–224, *May,* 1931.—A criticism of the work of Pokrowski and of Anderson on the upper limit of stellar masses. In the case of Pokrowski, his argument is shown to lead merely to an upper limit for the product of mass and density consistent with visibility, whilst in the case of Anderson an error in the sign of the potential energy is pointed out which vitiates his conclusion. G. C. McV.

**3754. Star Streaming. H. Mineur, Varchon, Barbier, Canavaggia, Chevallier and Roumens.** *Comptes Rendus,* 192. *pp.* 1357–1360, *June* 1, 1931.—The velocity of the sun is determined with respect to stars of different spectral types and at different distances from the sun. 5500 stars were made use of. The velocity of translation of the sun is found to be independent of the spectral type of the stars used to calculate it. The stars of type F and the dwarfs of type G, K, M do not give a different value of the velocity from that obtained from other stars. With regard to the differential rotation of the stars, the results agree with those of Oort and Plaskett. G. C. McV.

**3755. Composite Polytropic Gas Spheres. H. N. Russell.** *Roy. Astron. Soc., M.N.* 91. *pp.* 739–751, *May*, 1931.—From Emden's tables a set of curves, one for each value of $n$, are constructed. The diagram so constructed can be used to determine the nature of the solution of the equation of polytropic equilibrium in a spherical mass of gas, given the pressure and density at a given distance from the centre and the whole mass inside a sphere of this radius. This graphical method also gives very simply the result that if a sphere consists of two polytropic regions with an Emden solution in the inner region, the outer region can have a centrally-condensed solution only if $n$ is less than in the interior. If $n$ is greater, the solution in the exterior must be centrally-collapsed. For given solutions, centrally-condensed or collapsed, there is only one way in which a transition to an Emden solution for given $n$ may be made. The solutions of equations for $n > 5$ are dealt with to some extent. It is assumed throughout that the total pressure is proportional to the $\left(1 + \frac{1}{n}\right)$th power of the density. [See also following Abstract.]
G. C. McV.

**3756. Steady-State Distributions given by Solutions of Emden's Differential Equation. E. A. Milne.** *Roy. Astron. Soc., M.N.* 91. *pp.* 751–756, *May*, 1931.—H. N. Russell [see preceding Abstract] has shown that composite polytropic models with a centrally-condensed solution in the outermost region can only have finite central density if the polytropic index increases from zone to zone inwards. The limitations which underlie this result are now investigated. Milne shows that Emden's equation covers distributions in which Russell's assumption, $P \propto \rho^{1+1/n}$, where $P$ = total pressure, $\rho$ = density, $n$ = polytropic index, no longer holds. Examples are given in which Russell's result ceases to be true. Another case when Russell's proof breaks down is shown to occur when the opacities of the various zones are not equal, the composite polytrope under consideration being built on the standard model. G. C. McV.

**3757. Theory of the Variable Stars of the Family of Mira Ceti. G. Armellini.** *Accad. Lincei, Atti.* 13. *pp.* 313–317, *March* 1, 1931.—Mira Ceti is the head of a vast family of variable stars of long period. These stars are the youngest giants with density extremely small (about a millionth of that of water), of reddish colour and of photospheric temperature notably low (1500°–2000° C.). For the greater number of these variables the period lies between 250 and 400 days, and the amplitude of variation is large. Mira Ceti at its maximum brightness has a magnitude third or fourth, whilst at minimum it sinks to the ninth magnitude, *i.e.*, becomes one hundred or two hundred times less luminous. But what is very interesting and not yet completely explained is that if instead of measurements with the photometer the bolometer or thermoelectric pile is used to measure the change of radiant energy, then, instead of the change of radiation observed being in the ratio 200 : 1, it is in the ratio 3 : 1. Joy, and with him most modern astronomers, explain this by the observation that in this family of stars the luminous variation is connected with change of temperature. The author discusses this explanation and notes that on adopting for Mira Ceti the extreme temperatures generally admitted to-day, $-$ $T_M = 2300$ and $T_m = 1800$, there is a notable divergence between theory and observation. Such divergence is *real* and not due to a too rough calculation by Joy. The author explains the phenomenon by supposing that the variations of temperature are associated with a variation of the atmospheric transparency, in accordance with the "veil theory" advanced by Merill. Thus when Mira is at minimum brightness its atmosphere is less transparent for the short wave-lengths, perhaps from the presence of compounds which are formed at that low temperature. So while the infra-red rays—carriers of the greater part of the energy radiated outwards—would be able to pass without great loss, the visible rays would experience a notable absorption. In particular there is noted amongst the compounds the binoxide of titanium $TiO_2$, the presence of spectral bands of which indicates low temperature. J. J. S.

**3758. Variable Star Su Cygni. G. Tiercy.** *Arch. des Sciences*, 13. *pp.* 121–141, *May–June*, 1931.—This star is a Cepheid with a period of 3·85 days, a range of $6^{\mathrm{m}}\cdot 6$ to $7^{\mathrm{m}}\cdot 3$, and a spectrum varying from type A7 to F8. The curve of light and spectrum variation shows a very slight hump on the descending branch, which is much more marked in the curve of radial velocity. From the data, and assuming pulsation to be the cause, the mass is found to be 7 times as great as that of the sun and the mean radius 12 times as great. The radius varies with phase from nine to seven million km., and the curve of variation shows a prolonged maximum. The variations in colour index, temperature and pressure are also determined, and the curves of light and spectrum variation are compared with the results of Robinson at Harvard. M. A. E.

**3759. Sequences and Elements for the International List of Cepheid Variables.** *Harvard Coll. Obs., Bull.* 883. *pp.* 1–15, *June* 1, 1931.—A table gives a list of 10 fields, the positions of their centres, the number of polar comparisons, and those with secondary standards that have been used in deriving the sequences; all fields except one (No. 8) are in north declination, and have their scale and zero point of magnitudes based on polar comparisons only. Charts and notes are given for each field. The probable error of a tabulated magnitude is about a 20th of a magnitude. A chief difficulty is the uncertainty in the stars' photographic ranges, but in each field an attempt has been made to carry to the useful limit of the plates at least one sequence, so that additional faint comparison stars can be selected readily in the same field. For bright variables, magnitudes as bright as the plates permit are in general given. A. S. D. M.

**3760. Ionisation of Calcium in Cepheid Atmospheres. Emily M. Hughes.** *Harvard Coll. Obs., Bull.* 883, *pp.* 32–36, *June* 1, 1931.—The phase of light variation for 42 classical Cepheids has been plotted against degree of ionisation for each star, giving ionisation curves differing widely from star to star. All give greater ionisation than do long-period variables since they lack strong neutral Ca. There is a definite correlation between spectral class and degree of ionisation, the maximum for Cepheids falling between F5 and G0, the deviation from the mean curve being less than 3 intensity units; and similarly for long-period variables the average deviation is 4 or more intensity units, and the maximum falls decidedly later than for Cepheids; for cluster-type and short-period classical Cepheids (*e.g.*, SW Tauri) there is a steeply rising curve continuous with that for classical Cepheids, and falling to zero at the earlier spectral classes where

Ca is very weak. Regular variables of 100 days' period or less, intermediate and semi-regulars and those similar to RV Tauri, all fall on the long-period variables curve; U Monocerotis behaves like the Cepheids, and R Scuti seems to be an earlier spectral class of the long-period variable curve, with higher maximum than the regulars show. This discontinuity, together with the later maximum of the long-periods, seems to indicate a lower luminosity for these than for Cepheids. The author bears out Tiercy's conclusion that for Cepheids the earlier spectral class coincides with maximum ionisation rather than maximum light. A. S. D. M.

**3761. Rotation of Stars. E. A. Kreiken.** *Roy. Astron. Soc., M.N.* 91. *pp.* 756–777, *May*, 1931.—A new formula connecting the period of axial rotation with the diameter and mass of a star is derived on theoretical grounds. The formula is in good agreement with observation for the Cepheids and β Canis-Majoris stars. For spectroscopic binaries, the smaller the eccentricity of the orbits the better the agreement, as is to be expected on the fission theory of the formation of these systems. The author discusses the question as to whether or not the Cepheid stage necessarily occurs in the formation of a double star and concludes that it does not. The formula is also applied to the case of the sun and planets and gives very good agreement with observation. The paper concludes with a discussion of multiple systems. [See also Abstract 2631 (1931).] G. C. McV.

**3762. Axial Rotation and Spectra of Stars. R. Gunn.** *Phys. Rev.* 37. *pp.* 1573–1578, *June* 15, 1931.—Struve's remarkable relation [see Abstracts 403 and 2215 (1931)] between high observed axial rotations of stars and their bright line spectra is considered theoretically. It is shown that the two phenomena are closely related to the same electromagnetic effects that account for the anomalous solar rotation. High electromagnetic winds, resulting from crossed electric and magnetic fields, account for the high apparent rotational velocity and transfer sufficient momentum to the star in the course of stellar time to account for the high true rotations necessary to produce fission. The large electromagnetic wind velocities require the presence of comparatively large radial electric fields and it is shown that these can add sufficient additional excitation energy to the atmospheric ions to produce bright line spectra. Thus, high apparent axial rotations, high true rotations and bright line spectra in stars are intimately related and the existence of one usually demands the presence of the others. An approximate expression is derived for the time rate of increase of angular momentum in a star. AUTHOR.

**3763. New Method of Study of Galactic Rotation. H. Mineur.** *Comptes Rendus*, 193. *pp.* 222–224, *July* 27, 1931.—The galactic hypothesis explains our universe as a spiral of exceptional dimensions whose centre is 12,000 parsecs distant in the direction of Sagittarius (Long. 330°); the super-galactic hypothesis represents the Milky Way as a group of Spirals (like those of Coma Virgo and Centaurus), the centre of the group being in Sagittarius and the centre of the solar spiral in Carina (Long. 240°), distant about 200 parsecs [see following Abstract] Only the study of the stars as a whole can discriminate between these two. For the galactic hypothesis the author discusses the methods of Oort and Lindblad, showing that in the last place these depend on our knowledge of the solar system elements, so that a small error (say in the mass of Venus) may modify the whole. Dyson's terms and the second asymmetrical stream seem to support the super-galactic hypothesis, but these results might be interpreted as a differential rotation if the Ursa Major group were more numerous and scattered than is assumed. The author develops a method which leaves no uncertainty as to the position of the centre. He finds values for Φ and Ψ and traces the curves Φ = const., Ψ = const., and it is sought to represent them by circles whose centre is the rotation centre required, giving no ambiguity of direction, and the centre is found by kinematic considerations. B-stars and giants of G, K and M types are indicated for such a research. A. S. D. M.

**3764. Rotation Motion for all B-Type Stars. P. Guintini.** *Comptes Rendus*, 193. *pp*. 225–226, *July* 27, 1931.—The coordinates, $x$, $y$, $z$ (coincident with the velocity components $X$, $Y$, $Z$) have been computed for the three galactic axes. The sun's velocity with respect to B-stars is 20·0 km./sec. to A = 270°, D = + 28°; there seems no sensible variation of $X$ and $Y$ in terms of $z$. The method suggested by Mineur is followed [see preceding Abstract]. The stars are divided into 37 groups; stars of the same group are those whose $x$, $y$, are between the limits $x \mp 50$, $y \mp 50$ (parsecs); $x$ and $y$ varying $-300$ to $+200$. In each group the means $\overline{X}$, $\overline{Y}$, represent the whole velocity $\overrightarrow{V}$ of B-stars to the point $x$, $y$. By a graphical method Φ (rotational) and Ψ (divergence of $\overrightarrow{V}$) at different points in the galactic plane are found. Maximum Φ ($+ 8\cdot10^{-2}$) is in the 3rd quadrant near $x = -150$, $y = -150$, and Φ has negative values in the 1st quadrant; the curves Φ resemble circles round A as centre and this would place the centre of rotation of the stars considered in the constellation Carina about 200 parsecs from the sun, thus indicating the super-galactic hypothesis. Ψ is also at maximum ($+ 12\cdot10^{-2}$) in the 3rd quadrant near A′ ($x = -100$, $y = -50$) and decreases in going away from A′, attaining zero value at 200 parsecs; beyond this it is negative. There is a perturbation in the 4th quadrant where Ψ is near $+ 5\cdot10^{-2}$.
A. S. D. M.

**3765. Large Magellanic Cloud. Part III. Period-Luminosity Relation. H. Shapley.** *Harvard Coll. Obs., Bull*. 883. *pp*. 16–18, *June* 1, 1931.—A preliminary test, based on more than 200 stars from 70 plates, of the relation between period-length and photographic magnitude; periods for only 40 variables are determined, as the photographs range over 30 years. A table is given on the basis of deduced mean light curves; a " quality " is assigned to each period, these ranging from 2·5 to 39·2 days. The logarithm of the period is plotted against median absolute magnitude for distance modulus 17·10. Scattering of individual values is a little more than for the Small Magellanic Cloud, and this is due (probably) to errors, to obscuration by Cloud nebulosity, to Cloud thickness in the line of sight, and to real deviation of the periods or luminosities of Cepheids from average conditions. Period-luminosity relation is maintained in the Large as in the Small Cloud, and it will be found that practically all Large Cloud variables are normal Cepheids. Obscuring nebulosity may affect, in various degrees, Cepheid magnitudes throughout the Cloud, which on this account will be examined in detail in the future. [See also Abstract 2221 (1931).] A. S. D. M.

## LIGHT.

**3766. Transmission of Light by Thin Films of Metal. S. R. Swamy.** *Roy. Soc., Proc.* 131. *pp.* 307–320, *May* 1, 1931.—An ordinary gold leaf appears green by transmitted light while silver leaf appears blue. Faraday found that the gold leaf lost its colour if heated on glass. R. W. Wood obtained purple, blue and green films of gold by sputtering. Garnett [see Abstract 2523 (1904)] has explained the colours observed in these and similar experiments by considering the films as made up of minute spherical particles of metal. Most of the experiments hitherto made on the colour of films are qualitative, and the author describes in this paper quantitative observations on the colour variation of sputtered metal films on heating. The absorption spectra were photographed and the plates obtained measured with a photometer. Garnett, assuming that the films were composed of small metal spheres, with diameters small compared with the wave-length of light, and treating these as Hertzian oscillators, calculated the transmission coefficient of such films for various values of $\mu$, the volume of metal per unit volume of the film. The author compares theoretical curves, giving transmission coefficient against $\mu$, and the experimental curves giving transmission coefficient against temperature at various values of $\lambda$. Fair agreement occurs if the following assumptions are made: (1) $\mu$ diminishes steadily in a linear manner as temperature rises, (2) on heating the film breaks up and becomes non-uniform, becoming very thin in parts which thus act as " windows " and the true absorption effect is diluted with increasing amounts of white light, (3) the open area of these windows is a linear function of temperature. With these assumptions Garnett's theoretical results agree in some particulars with the experimental results described in the present paper. J. J. S.

**3767. Relative Visual Effectiveness of Spectral Radiation. H. Grundfest.** *Nat. Acad. Sci., Proc.* 17. *pp.* 359–366, *June*, 1931.—In man the discrepancy between visual data and visual purple absorption data is accounted for by the macular pigment. It is generally stated that this pigment migrates behind the light sensitive elements in the dark-adapted retina. However, the pigment may not move back completely and so may absorb some of the light which reaches the retina. Experiments on sun-fish seem to support this view. H. M. B.

**3768. Formation of Images in the Eye. H. Homann.** *Zeits. f. Physik*, 70. 5–6. *pp.* 348–352, *July* 6, 1931.—A fish eye, under water, does not see surrounding objects above the surface of the water with a larger field of view nor more distorted than the human eye. The position of clear sight, the yellow spot, is determined not only physiologically, but by purely physical conditions. C. B. A.

**3769. Reflection and Refraction in General Relativity. T. Levi-Civita.** *Pont. Accad. Sci., N. Lincei, Atti*, 84. *pp.* 332–352, *May* 17, 1931.—Whenever we deal with stationary phenomena Einstein's principle reduces to the principle of least time. The author shows that the laws of dioptrics can in this case be derived in a simple manner from the data of classical optics. E. E. F. d'A.

**3770. Index of Refraction of Soda-Lime-Silica Glasses as a Function of the Composition. C. A. Faick and A. N. Finn.** *Bureau of Standards, J. of Research,* 6. *pp.* 993–1002, *June,* 1931.—Twenty-one soda-silica and twenty-one soda-lime-silica glasses were made in platinum and the index of refraction and chemical composition of each glass were determined. From the data obtained equations were derived and a diagram was prepared showing the relations between index of refraction and composition of these glasses. The diagram makes it possible to predict with considerable accuracy (1) the index of refraction of any glass, in the range of compositions considered, from its composition and (2) the compositions of the various glasses which have the same index of refraction. Some evidence is presented indicating that index of refraction of the soda-silica glasses may be a simple function of certain soda-silica compounds which may be present in glass. AUTHORS.

**3771. Interchangeable Blown Glass Tubes for Magnetic Birefringence. P. Lainé.** *Rev. d'Optique,* 10. *pp.* 256–265, *June–July,* 1931. —The great precision with which it is necessary to maintain the orientation of the beam of light during a series of measurements of magnetic birefringence carried out with the large Bellevue electromagnet [see Abstract 2795 (1930)] has led to further efforts, here described, to perfect the parallelism of the end-faces so that the tubes used may be interchangeable. A method is also described for making containers with sealed end-faces of good optical quality. G. E. A.

**3772. Method of Measuring Weak Elliptically-Polarised Light in the Ultra-Violet. G. Szivessy and C. Münster.** *Zeits. f. Physik.* 70. 11–12. *pp.* 750–757, *July* 29, 1931.—This paper gives supplementary information concerning the control of the photographic method previously described by the authors [Abstract 1842 (1929)] for the measurement of weak elliptically-polarised light in the ultra-violet. H. H. Ho.

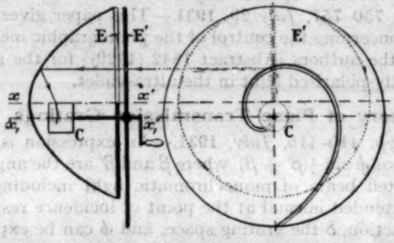
**3773. Theory of Plane Transmission Gratings. H. S. Uhler.** *J.O.S.A.* 21. *pp.* 410–415, *July,* 1931.—An expression is derived of the form $n\lambda/\delta = \cos\phi \sin \frac{1}{2}(\beta' + \beta)$, where $\beta$ and $\beta'$ are the angles of deviation of the diffracted beam of monochromatic light including and not containing the extended normal at the point of incidence respectively, $n$ the order of diffraction, $\delta$ the grating space, and $\phi$ can be expressed in terms of $\beta$ and $\beta'$. The formula is independent of the angle of incidence of the light. The first order terms of algebraic functions involving avoidable small errors are investigated, and the results are tabulated. R. S. R.

**3774. Interference Fringes of High Path-Difference Obtained by the Combination of Two Interference Systems with Different Dispersions. E. Lau.** *Ann. d. Physik,* 10. 1. *pp.* 71–80, *June* 24, 1931. —A multiplex-interference-spectroscope is described, by means of which interference fringes can be produced, which are to be explained as the result of the combination of the interferences occurring in the quartz plates and in the air film. The fringe-width of these new dispersion-difference fringes " has been calculated and verified experimentally. The fringes could still be recognised with a plate separation of 61 cm. From the discussion of the path differences involved, a value of at least 2·4 m. is obtained for the coherence-length, and this is shown by experiment to be independent of the nature of the light source. C. B. A.

**3775. Projection of Stereoscopic Images in Space. E. Estanave.** *Comptes Rendus*, 192. *pp*. 1367–1368, *June* 1, 1931.—Shows how to combine lenses so as to project the double image of an autostereoscopic plate [see Abstract 433 (1909)] with the effect of an image in relief suspended in space and looked at by direct vision. A. D.

**3776. Projection of Parallax Panoramagrams. H. E. Ives.** *J.O.S.A.* 21. *pp*. 397–409, *July*, 1931.—Difficulties in the projection of parallax panoramagrams arise from the low transmission of the screen and the extreme nicety of optical definition and registration required to project the panoramic strips upon the appropriate elements of the screen whatever its form. To overcome the poor transmission the projection screen is built up from a series of celluloid rods machined to the size and shape required and the rear surface has a diffusing finish. Difficulties arise from striations and aberration in the rods, and glass rods are considered as an alternative. Several methods are explained to obviate the other form of difficulty in the optical arrangements. [See also Abstract 819 (1931).] R. S. R.

**3777. Photographic Method for Determining the Profile of a Parabolic Reflector. P. Waguet, A. Stampa and J. Dourgnon.** *Comptes Rendus*, 192. *pp*. 1549–1550, *June* 15, 1931.—The method depends on the assumption that the reflector is a true surface of revolution. The screen E′ (see Fig.) is placed in front of the reflector whose axis is *xx′*. This screen is rotated about its axis *xx′*, by means of a handle. On the spindle is a small cylinder of photographic paper, C, the upper surface of which passes through *xx′*. It follows that the beam of light (indicated by the line with arrow heads) meets C at the point which is the focus for that zone of the mirror on which this beam is incident. The screen E′ has a narrow slot cut in the form of an Archimedean spiral and behind it is a second stationary screen E which has a narrow vertical slit in it, as shown by the dotted lines. It follows that as E′ rotates, the beam of light striking the mirror moves vertically up and down, its displacement from *xx′* being proportional to the angle of rotation of E′. The paper on C therefore gives a record of the change of position of the focus as the beam moves from axis to periphery. A second, less accurate, method is also described. J. W. T. W.



**3778. Dark Field Microscope Illuminator for Opaque Objects Producing Annular, Cross Fire and Indirect Illumination. J. J. Gerlach.** *Rev. Sci. Instruments*, 2. *pp*. 412–415, *July*, 1931.—An annular prism is mounted on bakelite by means of cement. Diffuse light from below is reflected by the silvered surface of the prism and refracted on emergence to strike the object at grazing incidence at the centre of the prism. The object is mounted on a microscope slide. High efficiency and strong illumination are obtained from a 40-watt, 110-volt lamp, or the beam of a small electric arc. Coloured filters may be used if desired. R. S. R.

**3779. Lateral Chromatic Aberration of Apochromatic Microscope Systems. I. C. Gardner and F. A. Case.** *Rev. Sci. Instruments,* 2. *pp.* 416–428, *July,* 1931. *Bureau of Standards, J. of Research,* 6. *pp.* 937–946, *June,* 1931.—Lateral chromatic aberration is left in apochromatic microscope objectives in order that a more perfect correction of spherical aberration over the whole visible spectrum may be obtained. Methods are described for the measurement of the lateral chromatic aberration and distortion of microscope objectives and eyepieces. The results of measurements on 20 apochromatic microscope objectives of four different makes and on 10 compensating eyepieces of two different makes are tabulated. The results show that chromatic aberration is not entirely compensated and the microscope system is usually under-corrected. The bearing of this on the performance of the system in photomicrographic work by a 3-colour process and in the direct visual observation of objects is considered in detail. R. S. R.

**3780. Improvements in Photo-Lithography. H. M. Cartwright, A. Haigh and E. L. Turner.** *Phot. J.* 71. *pp.* 266–273; *Disc.,* 273, *July,* 1931.—Discusses existing processes for making photo-litho plates. Indicates grounds for dissatisfaction with present methods: (1) the manner of making tonal alterations, and (2) the character and durability of the plate image. Methods of making tonal alterations are discussed with particular reference to colour correction. A practical system of colour correction is described, in which the chemical reduction of half-tone dot images is controlled quantitatively by means of colour charts. An original positive-reversal process for printing plates on zinc is described, involving the use of a bichromated gum stencil. The plates are intaglio-etched by means of a non-aqueous solution; many of the drawbacks associated with previous methods are avoided. A. H.

**3781. Effect of Environment on Photographic Sensitivity. Part III. Effect of Sodium Sulphite. S. E. Sheppard and E. P. Wightman.** *Phot. J.* 71. *pp.* 281–287, *July,* 1931. *Comm. No.* 349 *from the Kodak Research Lab.*—Previous work [see Abstract 2156 (1929)] has shown that presence of potassium bromide during exposure results in a marked reduction of sensitivity, whereas no effect is visible when treatment comes before or after exposure. This work shows the effect of sulphite present during exposure to be of the same order as that of bromide, whilst treatment before exposure lowers the sensitivity and treatment after lessens the latent image developability. Sodium sulphite also decreases the slope of the straight-line portion of the H. and D. curve. A. H.

**3782. Optical Sensitisation. W. D. Bancroft, J. W. Ackerman and Catharine Gallagher.** *Nat. Acad. Sci., Proc.* 17. *pp.* 407–410, *July* 15, 1931.—The theory of optical sensitisation is discussed, and the opinion (originally put forward by Vogel) is held that any sensitiser must be decomposed by light and must be either (*a*) a reducing agent or (*b*) be converted into a reducing agent by the action of light. A number of simple experiments are put forward in support of this view. A. H.

**3783. Speed of Photographic Emulsions. R. Davis and G. K. Neeland.** *J.O.S.A.* 21. *pp.* 416–419, *July*, 1931.—The H. & D. system of measuring the sensitiveness of photographic materials has been altered in recent years so that different characteristics of the emulsion now have the same name. It is recommended that the procedure in describing emulsion characteristics be clearly indicated. AUTHORS.

**3784. Latent Image Theory. W. Gramse.** *Zeits. f. wiss. Phot.* 30. 1–2. *pp.* 40–44, *May*, 1931.—The " halogen-acceptor " action of gelatin in a photographic emulsion is studied. Various addition products of gelatin with halogens may be formed; in an unripened emulsion these are unstable, and regression of the latent image occurs. A pure AgI emulsion cannot be given sensitivity by ripening, and this may be due to the fact that analogous gelatin-iodine compounds are not obtainable. Where a stable halogen compound is obtained, the gelatin is rendered insoluble in water. This is employed as a criterion of the induction of sensitivity, in a series of experiments on the addition to gelatin of " halogen-carriers " such as iodine, sulphur, etc. The greater light-sensitivity of an unripened AgCl emulsion (as compared with AgBr) is attributed to the probably more rapid action of Cl than of Br on gelatin in the absence of a halogen-carrier, though the situation is reversed when halogen-carriers (such as " ripening nuclei " of silver) are present. L. V. C.

**3785. Solarisation Phenomena in Negative Iron Processes. E. Stenger.** *Zeits. f. wiss. Phot.* 30. 1–2. *pp.* 45–48, *May*, 1931.—In the ferricitrate-ferricyanide process prolonged exposure produces a solarisation effect due to reduction of ferrous ferricyanide (Turnbull's blue) to the practically colourless ferrous ferrocyanide which, however, on oxidation in the atmosphere or by nitric acid yields a blue image of ferric ferrocyanide (Prussian blue). Ordinary gelatin dry plates were fixed and washed, sensitised by bathing in ammonium ferricitrate of various concentrations, exposed in a standard manner and developed in a corresponding range of ferricyanide solutions. Solarisation was found to vary directly with the concentration of the sensitiser and inversely as that of the developer. The production of ferrous salts on solarisation reverses the tanning of the gelatin and gives rise to relief effects. If exposure is prolonged beyond the solarising region a slight internal darkening occurs, analogous to the " second inversion " of silver gelatinohalide emulsions. L. V. C.

**3786. Instability of Halogen Salts of Silver and Photographic Changes in the Silver Halogen Plate. K. Fredenhagen and Marianne Wellmann.** *Zeits. f. phys. Chem. Bodenstein-Festband*, *pp.* 135–144, 1931. —The partial dissociation pressure of silver above the solid silver halogen salt was calculated from published vapour-pressure measurements. It is found that the partial dissociation pressure is several powers of ten higher than the saturation pressure of metallic silver. The gas phase above the solid silver halogen salt was therefore supersaturated. The action of light on the photographic plate and the changes taking place during development are treated as a releasing of the super-saturation. This point of view is utilised to explain other phenomena in connection with the photographic plate. F. J. B.

**3787. Photographic Action of α-Rays. J. Eggert and F. Luft.** *Zeits. f. phys. Chem. Bodenstein-Festband*, *pp.* 745–754, 1931.—The photographic action of α-rays on a photographic layer has been macroscopically and microscopically investigated. The amount of blackening with different experimental conditions was examined. The relation between the range of the α-rays in the photographic layer and the silver bromide concentration was determined. It was proved experimentally that each grain struck by an α-particle became capable of photographic development. The ranges measured by the photographic method are identical with those found by other methods. H. N. A.

**3788. Photographic Action of Kathode Rays of Moderate Velocity. A. Becker and E. Kipphan.** *Ann. d. Physik*, 10. 1. *pp.* 15–51, *June* 24, 1931.—The photographic action of kathode rays of velocity between 15–100 kV has been studied using three different types of plate. In all cases it is found that for kathode rays of given velocity the amount of blackening is dependent only on the number of electrons which have struck the plate and is independent of the rate at which they strike. The amount of blackening S is related to the number of electrons which have struck the plate, Q, by the equation $S = C \log (aQ + 1)$, where C and $a$ are constants. The initial photographic sensitivity of the plates used is proportional to the energy of the rays over the whole range investigated. The photochemical yield, *i.e.*, the number of silver grains developed per incident electron, has also been studied. F. J. W.

**3789. Action of Slow Electrons on Photographic Emulsions. R. E. Burroughs.** *Rev. Sci. Instruments*, 2. *pp.* 321–328, *June*, 1931. *Comm. No.* 463 *from the Kodak Research Lab.*—The experiments described lead to the conclusion that the latent image produced by slow electrons is mainly due to radiations excited by the electrons in the residual gas about the plate and not to the sensitive grains being hit by the electrons and absorbing energy directly. The nature of this residual gas, and not the character of the plate, determines the lower energy limit recorded.
A. H.

**3790. Precision Luxmeter. P. Fleury.** *Comptes Rendus*, 192. *pp.* 1715–1717, *June* 29, 1931.—The instrument embodies a blue wedge in addition to a neutral wedge in front of the comparison lamp. The object is to obviate a difference in colour of the field which precludes accurate matching. In addition, the blue wedge serves to correct a want of neutrality in the grey wedge. It is claimed that the instrument will measure the illumination of one-hundredth lux with an accuracy of a few per cent. F. S.

**3791. Waidner-Burgess Standard of Light. H. T. Wensel, W. F. Roeser, L. E. Barbrow, and F. R. Caldwell.** *Bureau of Standards, J. of Research*, 6. *pp.* 1103–1117, *June*, 1931.—A source of light sufficiently reproducible to serve as a fundamental photometric reference standard has been obtained by carrying out the original suggestion of Waidner and Burgess to immerse a hollow inclosure in a bath of molten platinum and to make observations during the period of freezing [see Abstract 1786 (1908)]. The platinum, of exceptionally high purity, was contained in thorium oxide crucibles and was heated by means of a h.f. induction furnace. The brightness of the source, reproducible to 0·1 %, was 58·84 international candles per sq. cm. The platinum used was not appreciably contaminated by being melted and frozen over 100 times in crucibles of fused thorium oxide. Various tests indicated that the platinum was at all times purer than 99·997 %. **Authors.**

**3792. Molecular Association and Optimum Fluorescence in Solution. Influence of Salts. F. Perrin.** *Comptes Rendus,* 192. *pp.* 1727–1729, *June* 29, 1931.—The variation of the concentration for optimum fluorescence of a substance in solutions of different solvents is not explicable simply on the basis of deactivating kinetic theory collisions. It is suggested that an old hypothesis due to Walter—that of association of the dissolved molecules—is possibly the explanation of the decrease of fluorescence in concentrated solutions. Addition of KCl to a solution of potassium fluoresceinate lowers the optimum concentration considerably, and a distinct absorption band occurs in the KCl solution which appears only as a slight hump in the pure aqueous solution. This band is taken to be due to associated molecules. But fluorescent deactivation by association is not sufficient to account alone for the magnitude of the decrease with concentration, and it is further supposed that the associated groups further deactivate other active molecules by proximity. It is, however, not necessary for molecular association to exist in order to obtain an optimum concentration for fluorescence. [See also Abstract 1200 (1931).] J. E.

**3793. Solarisation of Fluorite and the Law of Lumino-Transformation. S. Iimori and E. Iwase.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 311. *pp.* 41–67, *July,* 1931. *In English.*—The phosphorescence was examined photographically, the density of the exposures being obtained photoelectrically. It is found that (1) The luminosity rises to a maximum under prolonged excitation and then gradually degrades. This degradation is termed "solarisation." (2) The mechanism consists of successive irreversible transformations called lumino-transformation. (3) The end product can be restored to the original state by the action of $\gamma$- and X-rays. (4) Equations expressing growth and decay of photoluminescence of fluorite have been deduced theoretically, and the experimental study enables the transformation constants of the supposed four members of the series to be calculated. J. E.

**3794. Emission of Phosphors in Varying Electric Fields. H. Hinderer.** *Ann. d. Physik,* 10. 3. *pp.* 265–295, *July* 11, 1931.—Different phosphors were studied in both constant and varying electric fields. The luminosity of a ZnS-Mn phosphor in both kinds of field is dependent on the metal content. The effect of the field is different in the different centres, being small on the centres of short duration, greatest on those of medium duration and slightly quenching on the long duration centres. The actual effect then of a field gives information as to the make up of the phosphor. The duration of the phosphorescence excited by an electric field is independent of the field strength and the size of the centre. J. E.

**3795. Possibility of Impulse and Energy Exchange between Light Quanta. H. Bauer.** *Zeits. f. Physik,* 70. 1–2. *pp.* 38–42, *June* 20, 1931.—An experiment is suggested and discussed by which Poynting's source-free energy current should produce a change of frequency of the light quantum used as probe. After the establishment of the idea of the "action-cross-section of a light quantum of the frequency $\nu$ in a source-free energy stream of magnitude G" a connection is shown between the magnitude of the action-cross-section and the looked-for frequency change.

From a fully set forth case there results that an action-cross-section of $2 \times 10^{-27}(\text{cm.})^2$ is still observable. The suggested experiment is compared with the experiments which from other directions are discussed or brought forward for the detection of an impulse and energy exchange between light quanta. In conclusion there is a short consideration of the principle of undisturbed superposition. J. J. S.

**3796. Absorption Spectra of the Rare Earths. Y. Uzumasa and H. Okuno.** *Chem. Soc. Japan, Bull.* 6. *pp.* 147–152, *June,* 1931.—The absorption bands of the nitrates of neodymium and praseodymium dissolved in various solvents are studied and it is found that, whilst no relationship is observable between the shift in position of the bands (from one solvent to another) and the refractive index of the solvent, there does appear to be some connection between the shift and the dielectric constant of the solvent. A. H.

**3797. Absorption Intensity for the Line 2537 Å. of Dissolved Mercury. H. Reichardt.** *Zeits. f. Physik,* 70. 7–8. *pp.* 516–518, *July* 14, 1931.—An investigation as to whether the absorptive power of the mercury atom is altered by solution (in hexane). There appears to be no alteration. J. E.

**3798. Absorption Spectrum of Aluminium Hydride. L. Farkas.** *Zeits. f. Physik,* 70. 11–12. *pp.* 733–749, *July* 29, 1931.—This absorption spectrum has been investigated for different hydrogen pressures for the purpose of elucidating the causes of line broadening and the pressure effects previously observed by Bengtsson and Rydberg. [see Abstract 2173 (1930)]. H. H. Ho.

**3799. Comparison of the Absorption Spectra of Complex Salts of Tervalent Cobalt and Chromium. M. Châtelet-Lavollay.** *Comptes Rendus,* 193. *p.* 30, *July* 6, 1931.—The wave-lengths of the ultra-violet absorption maxima of the luteo-, roseo-, purpureo-, and xantho-cobaltic salts differ by a constant amount (120 Å.) from the corresponding wave-lengths for the analogous chromium compounds. The evidence suggests that the only known type of xantho-chromic salts is of the *iso* type, *i.e.*, is represented by the formula $[Cr(NH_3)_5NO_2]Cl_2$. H. F. G.

**3800. Absorption Spectra of Cobaltous Compounds. Part III. Pyridine and Quinoline Complexes and Solutions. W. R. Brode.** *Am. Chem. Soc., J.* 53. *pp.* 2457–2468, *July,* 1931.—In this continuation of previous work [see Abstract 128 (1929)], a spectrophotometric study is made of cobalt chloride, cobalt bromide and cobalt iodide dissolved in pyridine and quinoline, and the relation between the data observed and those previously presented on the corresponding acid solutions is discussed. Evidence is presented to substantiate the existence of three absorption systems in blue cobalt solutions, namely, the halogen acid system, the pyridine-quinoline system and a possible intermediate system. F. S.

**3801. Absorption Spectrum of Oxygen at High Temperature. D. Malan.** *Comptes Rendus,* 192. *pp.* 1720–1721, *June* 29, 1931.—The object was to investigate the transformation of ozone in oxygen at high temperature, when it was expected that the strong absorption of ozone in the ultra-violet would be modified. The absorption of oxygen is, however, increased as the temperature is raised to 1400° C. Twenty-four band heads were observed between 2160 and 2360Å. F. S.

**3802. Ultra-Violet Absorption of Fluorine. H. v. Wartenberg, G. Sprenger and J. Taylor.** *Zeits. f. Chem. Bodenstein-Festband, pp.* 61–68, 1931.—The absorption of fluorine in the ultra-violet was measured with a quartz spectrograph and sector photometer, using a hydrogen discharge tube as source. From the position of the absorption maximum a heat of dissociation of 63·3 k. cal. is deduced for $F_2$. The possibility of $F_2$ and $H_2$ uniting when illuminated was also investigated, but they were found not to combine even under very favourable conditions. F. S.

**3803. Absorption Spectra of the Halogen Cyanides. R. M. Badger and S. C. Woo.** *Am. Chem. Soc., J.* 53. *pp.* 2572–2577, *July*, 1931. —The absorption of the gaseous halogen cyanides has been investigated in the ultra-violet. Regions of continuous absorption only were found, with the following long wave-length limits: ClCN, $\lambda > 2270$; BrCN, $\lambda > 2450$; ICN, $\lambda > 2900$ and $\lambda > 2100$. The similarity of the spectra and their relation to each other suggest a similar structure for all three molecules. Consideration of thermochemical and spectroscopic data together shows that in the normal state the halogen cyanide molecules are built from normal halogen atoms and normal cyanide radical, and in the first excited electronic state from normal halogen atom and an excited CN radical in the $^2\Pi$ state. The structures are probably those represented by the formulæ ClCN, BrCN, ICN. The thermochemical heats of formation of the ClCN and ICN seem to be in substantial agreement with the spectroscopic values. AUTHORS.

**3804. Absorption Spectra in Relation to the Colour of Solutions of Iodine Monochloride. A. E. Gillam and R. A. Morton.** *Roy. Soc., Proc.* 132. *pp.* 152–167, *July* 2, 1931.—This work continues a previous investigation [see Abstract 158 (1930)], and deals with the spectral absorption of iodine monochloride in carbon tetrachloride, chloroform, acetic acid, hydrochloric acid, ether and ethyl acetate. Iodine chloride solutions are found to exhibit two different colours, yellow and brown, the yellow solutions being characterised by an absorption maximum about 350 to 360 $\mu\mu$, whilst the head of the band for the brown solutions is situated near 460 $\mu\mu$. The molecular extinction coefficient in each case is between 150 and 160. The gradual appearance of a second band in the case of ether and ethyl acetate solutions is shown to be due to chlorination of the solvents with liberation of free iodine, which exhibits a maximum (in these solvents) near 460 $\mu\mu$. In spite of the coincidence in wave-length, the new band thus differs in origin from the band due to iodine monochloride in saturated solvents. The aqueous sodium chloride and hydrochloric acid solutions are anomalous (much higher extinction coefficients), indicating the existence of ICl . NaCl and ICl . HCl respectively. The dichroism of iodine chloride solutions is found to be exactly analogous to that of iodine solutions, and in certain cases the analogy extends to variations with temperature. The ageing of iodine chloride solutions is also examined and discussed. H. H. Ho.

**3805. Investigations in the Infra-Red of the Spectrum. Part III. Absorption Spectrum of Carbon Disulphide. Part IV. Monochromator Method in the Infra-Red. C. R. Bailey and A. B. D. Cassie.** *Roy. Soc., Proc.* 132. *pp.* 236–257, *July* 2, 1931.—The infra-red absorption spectrum of $CS_2$ vapour was examined between 1 and 22 $\mu$. Four bands were located, and resolution into P and R branches was achieved in three

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cases. The infra-red was coordinated with the Raman spectrum, and the fundamental frequencies of the molecule deduced. The molecule was shown to be rectilinear, and its moment of inertia evaluated. The force constants characteristic of the linkages in this and similar molecules were calculated and deductions as to the nature of the binding made. A suggestion is offered in explanation of the characteristic doublet in the Raman spectrum of $CS_2$ and $CO_2$. The errors arising when interchanging long absorption tubes in the optical path and when working at low gas pressures are avoided by having the tubes at rest and the beam swung through each tube in turn by the use of mirrors. The spectrometer is used as a monochromator, and mirrors form an image of the slit on the thermopile junctions. This arrangement has a further advantage in that some substances to be tested undergo photochemical decomposition with great ease, and the original method is impracticable if not dangerous. Experimental details are supplied. Errors due to stray radiation and scattered light are reduced to a minimum. [See also Abstract 1535 (1931).] R. S. R.

**3806. Visible and Ultra-Violet Absorption Spectra of Carotin and Xanthophyll and the Changes Accompanying Oxidation. H. J. McNicholas.** *Bureau of Standards, J. of Research,* 7. *pp.* 171–193, *July,* 1931.—The absorption spectra of equal molecular concentrations of pure carotin and xanthophyll in alcohol-ether solution are studied throughout the visible and ultra-violet spectral range, and the changes in these spectra are followed as the pigments oxidise slowly in solution. The frequencies of the absorption bands for each pure unoxidised pigment appear to form a regular sequence extending throughout the observed spectral range and converging toward the lower frequencies in accordance with a simple parabolic law for each pigment. The imposition of a periodic variation in intensity on this progression of bands gives the appearance of three adjacent spectral regions of selective absorption which are partially resolved into overlapping component bands. During oxidation of the pigments both spectra pass through the same characteristic series of changes, which are such as to indicate two very definite stages in the oxidation process for each pigment. Carotin is not oxidised to xanthophyll in this process, as contended by some previous investigators. The stages of oxidation are closely related to the two stages of hydrogenation described by Zechmeister and his associates. The oxidation data confirm the contentions of Schertz and others that the different xanthophylls described by Tswett may represent distinct stages in the oxidation of a single pigment. AUTHOR.

**3807. Refinement of the Summation Law. E. Wigner.** *Phys. Zeits.* 32. *pp.* 450–453, *June* 1, 1931.—The actual calculation of transition probabilities is possible only to an approximate extent, in spite of the discovery of the summation law. The author gives a more rigorous statement of the summation law which allows the transition probabilities to be calculated more accurately in some cases. H. L. B.

**3808. Spectra of "Stripped Atoms." K. Bechert.** *Zeits. f. Physik,* 69. 11–12. *pp.* 735–741, *June* 13, 1931.—Applications of Goudsmit's formula for the separation-factor of multiplet terms to the spectra of "stripped atoms." For spectra of the type of Mg or Be the symmetrical character of the PP′ groups follows from the formula in the first approximation, if Russell-Saunders coupling is assumed. The discrepancies between the actual values of the terms and those given by the Landé interval-rule are shown to be in the direction predicted by the theory. But for the PP′ groups in spectra similar to that of S the discrepancies predicted by the theory are in the opposite direction to those observed. The formula is also applied to the PP′ groups in the spectra of $C^+$ and $Si^+$. G. C. McV.

**3809. Multiplets in the Spark Spectrum of Bromine. L. and E. Bloch and P. Lacroute.** *Comptes Rendus*, 193. *pp.* 232–233, *July* 27, 1931.—The two triplets at 4705–4817 Å. and 4735–4849 Å. belong to the quintuplet system of BrII and correspond with the triplets observed by Paschen in the Cl II spectrum. Various groupings suggested by other workers are regarded as improbable. H. F. G.

**3810. Emission Spectrum of Compressed Hydrogen. W. Finkelnburg.** *Zeits. f Physik*, 70. 5–6, *pp.* 375–394, *July* 6, 1931.—A steel spark chamber was constructed in which hydrogen could be compressed up to 30 atmospheres. The observed widening of the lines can be explained as an interatomic Stark effect, the field in the discharge being from 200,000 to 2,000,000 volts per cm., and corresponding to 15 % ionisation. It was also observed that the metal sputtered from the electrode gave rise to lines which showed widening. In the case of copper it was found that the lines are proportional to the partial pressure of the metal vapour which is in turn proportional to the total pressure in the tube. F. S.

**3811. Resonance Spectrum of Sulphur Vapour. J. Fridrichson.** *Zeits. f. Physik*, 70. 7–8. *pp.* 463–467, *July* 14, 1931.—Some new terms of the doublet and multiplet series of the sulphur resonance spectrum excited by Hg vapour light in the region between 5000 and 6000 Å. are given. It has also been established that an alteration of the vapour pressure alters the intensity ratio of the doublet components in some series. A quantitative explanation of this alteration is attempted. J. E.

**3812. Some "Tail" (Schwanz) Bands of the Negative Nitrogen Group. D. Coster and H. H. Brons.** *Zeits. f. Physik*, 70. 7–8. *pp.* 492–497, *July* 14, 1931.—The rotation structure of two of the $N_2^+$ bands, which tail off into the red, are analysed, and it is shown that these bands belong to the same system as the $N_2^+$ band which tails off into the violet. J. E.

**3813. Spectrum of NaII. S. Frisch.** *Zeits. f. Physik*, 70. 7–8, *pp.* 498–507, *July* 14, 1931.—The sodium spark spectrum excited in a discharge tube with hollow kathode has been photographed and analysed in the first and second order of a concave grating. The scheme previously given for NaII [see Abstract 2384 (1928)] is extended. J. E.

**3814. D-Line Emission in Sodium Vapour with Yellow Light Excitation. A. Jabłoński and P. Pringsheim.** *Zeits. f. Physik*, 70. 9–10, *pp.* 593–602, *July* 22, 1931.—The D lines excited in the vapour at 300° by white light undoubtedly owe their origin to excitation by wave-lengths near the D lines. Addition of $N_2$ has almost as much extinguishing effect on them as on the resonance emission. The $D_1$ line is unpolarised, but the $D_2$ line is 19 % polarised. The intensity ratio is $D_2 : D_1 = 1 \cdot 7$. By excitation with light in which the D lines are broadened Na vapour shows resonance at 120°, which becomes diffused at 200°, and passes over into surface resonance. Above 250° a sharp cone of fluorescence is to be seen within the body of the vapour. This light, which is unpolarised at 200°, is 30 % polarised at 250°, and still 12 % polarised at 300°. The light emitted at higher vapour pressures is neither scattering nor resonance, but probably fluorescence of weakly-bound $Na_2$ molecules. J. E.

**3815. Recombination Emission in the Mercury-Arc Discharge. H. Kessel.** *Zeits. f. Physik,* 70. 9–10. *pp.* 614–634, *July* 22, 1931.—If helium or neon is introduced into the mercury arc strong recombination emission occurs; the limit ($2^3P_2$) at 2491 Å. is strongly evident, but the resonance line at 2537 Å. is relatively weak, and the forbidden line $2^3P_2 - 1'S_0$ at 2270 Å. is entirely suppressed. If argon is introduced into the arc the result is very different, since there is then no recombination emission, and the line at 2537 Å. is strong, whilst that at 2270 Å. is easily visible. Addition of hydrogen causes this second type to revert to the first type. In the argon type the electronic energy is always greater than in the neon type. It is suggested that at high concentrations of $2^3P$ mercury atoms the recombination emission is prejudiced by the occurrence of collisions of the second order, which raise the mean electronic energy at the expense, principally, of the slower electrons. H. F. G.

**3816. Arc Spectrum of Rhenium. W. F. Meggers.** *Bureau of Standards, J. of Research,* 6. *pp.* 1027–1050, *June,* 1931.—With pure potassium perrhenate on silver electrodes, the arc and spark spectra of rhenium have been photographed from 2100 Å. in the ultra-violet to 8800 Å. in the infra-red; more than 3000 new spectral lines have been recorded in this range. Only the lines appearing in the arc spectra with wave-lengths exceeding 2500 Å. are presented at this time. About 25 % of the 2000 or more lines herein described show hyperfine structure of 2 to 6 or more components. The centres of gravity of complex lines have been determined and are assumed to represent the effective wave-lengths for purposes of analysing the gross structure of the ReI spectrum. About 500 lines, including all those of intensity greater than 20 on a scale of 1 to 2000, have been classified as combinations of 115 levels, belonging to quartet, sextet, and octet systems, but only a part of the levels have been completely identified. The *raie ultime* is recognised as the line at 3460·47 Å., $a^6S_{2\frac{1}{2}} - e^6P^{\circ}_{3\frac{1}{2}}$, the normal state of the neutral Re atom being represented by $(d^5s^2)\ a^6S_{2\frac{1}{2}}$. Series forming terms have been identified which indicate that the ionisation potential is approximately 7·85 volts. AUTHOR.

**3817. Intensity Measurements in Band Spectrum of Lithium. W. R. van Wijk and A. J. van Koeveringe.** *Roy. Soc., Proc.* 132. *pp.* 98–107. *July* 2, 1931.—The intensity ratio for the strong to the weak rotational lines has been measured in the bands 4900 Å., 4838 Å. and 6554 Å., and found to be equal to 1·63. This result is in agreement with that of Harvey and Jenkins [see Abstract 3130 (1930)]. For the intensity ratio for the Q lines to the P lines in band 4900 Å. the value 2·0 has been obtained. From the optical determination of the relative abundance of the isotopes a value 7·2 for the ratio of the $Li^7$ to the $Li^6$ atoms has been found, which is not in agreement with the ratio 13 as calculated from the atomic weight. AUTHORS.

**3818. Wave-Length Measurements of Rubidium Lines. R. Ramb.** *Ann. d. Physik,* 10. 3. *pp.* 311–324, *July* 11, 1931.—The spectrum was excited in a vacuum tube and interferometric measurements made of wave-lengths in the region 5169–10,075 Å. The measurements are used to test the arrangement of the various series of rubidium. From an anomaly of intensities in the fundamental series it is deduced that the $3^2D$ term is inverted, while from considerations of the variation in $\Delta\nu$ in the same series it seems probable that the F terms are also inverted. F. S.

**3819. Structure of the F Terms of Rubidium. K. W. Meissner and O. Masaki.** *Ann. d. Physik*, 10. 3. *pp.* 325–328, *July* 11, 1931.—A discussion of the results given in the previous paper [see preceding Abstract]. F. S.

**3820. Spectra of the Corona Discharge. H. Oyama.** *Tôhoku Univ., Technol. Reports*, 10. 1. *pp.* 1–10, 1931.—A spectroscopic examination is made of the corona discharge in air over a range of pressure varying from one atmosphere down to 0·001 mm. of Hg. The luminosity of the corona is found to be due chiefly to the $N_2$ bands, and of these the second positive bands are by far the strongest. The OH and NO$\gamma$ bands are also observed, but no $O_2$ bands are found. O and N lines are also observed, but these are very weak. A. H.

**3821. Quantitative Spectral Analysis Using the Negative Glow of the Arc. R. Mannkopff and C. Peters.** *Zeits. f. Physik*, 70. 7–8. *pp.* 444–453, *July* 14, 1931.—In a small boring in the tip of the kathode of a carbon arc is placed a quantity of a substance containing a little of a second one which is to be quantitatively estimated. The spectrum of the bright spot on the kathode is photographed, and reveals the presence or absence of the second substance. Tests with known proportions give the least detectable percentage. The kathode glow possesses several advantages over the luminous gas column of the arc as a source. Its lines are much more intense, and this allows much smaller quantities of the second substance to be detected. The natural stability of the glow itself renders the conditions much more constant than in the use of the gas column. Evaporation from the kathode enables substances of widely differing boiling points to be estimated. Admixtures of 0·0001 % of Ga, Ge, Be, Sc, Pb, Cd and Al can be detected in from 1 to 4 mg. of substance. The photometric work of Gerlach and Schweitzer on homologous pairs of lines is used in various cases to determine the proportion of the second substance with considerable accuracy. N. D.

**3822. Origin of the Light from the Negative Glow. R. H. Sloane and K. G. Emeléus.** *Phil. Mag.* 12. *pp.* 73–80, *July*, 1931.—Druyvesteyn's conclusion [see Abstract 3730 (1930)] that the negative glow of the normal glow discharge in Ne and A gives an excitation light has been shown to be in agreement with the similarity of the intensity distribution for AI lines in the negative glow and positive column, and also to agree with the electrical analysis of the negative glow. It is pointed out, with special reference to He, that this conclusion is not necessarily valid for all gases. AUTHORS.

**3823. Axiality of Light Emission of Canal Rays. R. v. Hirsch and M. Schön.** *Zeits. f. Physik*, 70. 5–6. *pp.* 409–428, *July* 6, 1931.—An experimental arrangement is described for observing the light emission from a stream of canal rays in various directions, and for comparing the intensities. Observations were made both for helium lines in hydrogen and for hydrogen lines in helium. The effect of change in pressure is also discussed in detail. A further section is devoted to a description of results with improved apparatus. F. S.

**3824. Excitation of Continuous Spectra by Kathode Ray Bombardment. W. M. Cohn.** *Zeits. f. Physik*, 70. 9–10. *pp*. 662–694, *July* 22, 1931.—The first part of the paper deals with the aim of the investigation and with particulars of the apparatus used. The second part deals with considerations of the " auto-electronic " or " æona " discharge. An intensity maximum is found at 4500 Å., the spectrum extending from 6500 Å. to at least 2150 Å. The third part deals with the spectrum excited by discharge between a cylinder of thorium as anode and a point as kathode. Spectra are reproduced and discussed in relation to such effects as polarisation. F. S.

**3825. Molecular Spectra and Structure of the Molecule. H. Deslandres.** *Comptes Rendus*, 192. *pp*. 1417–1421, *June* 8, *and pp*. 1606–1610, *June* 22, 1931.—This is a continuation of previous work under the same title [see Abstract 2693 (1931)]. The gases now discussed include $CH_4$, $C_2H_2$, $C_2H_4$, CO, $N_2O$, $NO_2$, NO, $CO_2$ and $NH_3$. F. S.

**3826. Molecular Spectra of Mercury, Zinc, Cadmium, Magnesium and Thallium. H. Hamada.** *Phil. Mag*. 12. *pp*. 50–67, *July*, 1931. —The molecular spectra of these metals are investigated, employing the hollow kathode method devised by Schuler. Lines and bands in the several spectra are tabulated and briefly discussed. The results indicate that, generally, a " band system " emitted from these diatomic molecules has two broad maxima and one flat minimum of intensity. One of these maxima always coincides with the resonance line $1'S_0 - 2'P_1$ or $1'S_0 - 2^3P_{0,1,2}$, and the other lies on the longer wave-length side of this line. In the region about this second line there is, as a rule, a generally coarse structure, each band occasionally accompanying some finer structure The intensity of the shorter wave-length side from the resonance line gradually decreases and terminates rather suddenly, and that of the longer wave-length side from the second maximum also decreases gradually to a point where the band system suddenly fades. The results are briefly discussed in the light of theoretical considerations advanced by Born, Franck, Condon, Winans and Kuhn. J. S. G. T.

**3827. Λ-Type Doubling and Electronic Configurations in Diatomic Molecules. R. S. Mulliken and A. Christy.** *Phys. Rev*. 38. *pp*. 87–119, *July* 1, 1931.—A restatement is given of van Vleck's equations for Λ-type and spin doubling in $^1\Pi$, $^2\Sigma$ and $^2\Pi$ states; the results are applied to molecular data (including intermediate coupling cases), and an excellent fit is obtained. In the complicated case of CaH good agreement is obtained, some doubtful J values are revised, and a new branch is identified. In some of the molecules having both $\Sigma$ and $\Pi$ states the two states behave as though their electronic configurations were alike in all respects save that one electron has $\lambda = 0$ in the $\Sigma$ state, and $\lambda = 1$ in the $\Pi$ state. This suggests that the $n$ and $l$ values previously assigned to the outer electrons in hydrides have almost the same significance as they would in atoms formed by uniting the H nucleus with the heavier nucleus. In another type of case ($He_2$, $Li_2$ and $Na_2$) the electronic orbits of the molecule are apparently very similar to those of the two separate atoms. A. H.

**3828. Intensity and Natural Width of Spectral Lines. E. F. M. van der Held.** *Zeits. f Physik*, 70. 7–8. *pp*. 508–515, *July* 14, 1931.—A general solution of the integral occurring in the absorption theory is given. It appears that in most cases this integral can be explained as expressing only the Doppler widening, together with a linear part depending on vaporisation. The total absorption can for practical purposes be determined by graphical integration. J. E.

**3829. Collision Broadening of Spectral Lines and Energy Output at Collision. A. Jabłoński.** *Zeits. f. Physik,* 70. 11–12. *pp.* 723–732, *July* 29, 1931.—Considering the quantum jump as an instantaneous process, collision broadening of lines in the case of collisions of the first and second kind and of sensitised fluorescence is investigated on the lines of Franck's potential curves for the interchange interaction energy between two atoms in a molecule. It is suggested for the purposes of the explanation that there is interchange between kinetic and excitation energy, differences in effective cross-section for different kinds of collision, asymmetry of intensity distribution and characteristic effect of added gas for collision broadening, excitation function, and resonance by collision. The assumptions are of a qualitative nature. J. E.

**3830. Emission Spectra and Predissociation in OH and NH. J. R. Bates.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 329–332, 1931. *In English.*—The bands ascribed to the OH group are those around 3000 and 2800 Å., known as the water bands, while the ammonia bands at 3360 and 3370 Å. have been analysed by Hulthen and Nakamura and shown to be emitted by the NH group. From these bands, with predissociation taken into consideration, the characteristics of the three band groups are deduced. From the vibrational levels thus obtained the heat of dissociation of OH is calculated at 116·05 k. cal., and that of NH at 102·2 k. cal. F. S.

**3831. Hyperfine Structure. G. Racah.** *N. Cimento,* 8. *pp.* 178–190, *May,* 1931.—Discusses the causes of the discrepancies amongst the values of the magnetic moments of atomic nuclei deduced by Fermi's formula from the hyperfine structure of the spectral lines. The relativity correction which should be applied to Fermi's formula has been calculated and the influence of the finite size of the atomic nucleus evaluated, but it has not been found possible to reconcile the theoretical and experimental results. H. F. G.

**3832. Hyperfine Structure of Tl II. J. C. McLennan and M. F. Crawford.** *Roy. Soc., Proc.* 132. *pp.* 10–21, *July* 2, 1931.—The hyperfine structure of the Tl II spectrum is investigated in the spectral region 7100–2300Å. high resolution being obtained in various orders of a 3-m. concave grating of 60,000 lines. From the separations and intensities of the hyperfine structure components the nuclear moment $I = \frac{1}{2}$ for Tl is confirmed. The hyperfine structure separations of a line are valuable as a means of confirming its term classification, and in this way previous erroneous classifications are corrected and new terms are discovered. The components of fifty-seven lines are tabulated, and the corresponding hyperfine structure separations of about thirty terms are deduced. A theoretical treatment of the results is reserved for a later paper. J. E. K.

**3833. Raman Spectra and Constitution of Nitric Acid in Aqueous Solution. R. Brunetti and Z. Ollano.** *N. Cimento,* 8. *pp.* 169–177, *May,* 1931.—The Raman spectra of 2·7–13·4 M solutions of nitric acid have been studied. There are three principal groups of lines: the first, consisting of lines at 720, 1049 and 1400 cm.$^{-1}$, is attributed to the $NO_3$

group, whilst the second, which appears only with solutions of 10 M approx., and of which the origin is obscure, consists of lines at 640, 690, and 950 cm.$^{-1}$. The third group, characterised by a line at 1306 cm.$^{-1}$, appears only at concentrations above 7 M, and is ascribed to the $NO_2$ group. This view is confirmed by observations with solutions of sodium nitrite and by the measurements of other workers with organic nitro-compounds, and supports the hypotheses that in concentrated nitric acid solutions there exists the grouping $NO_2OH$. H. F. G.

**3834. Continuous Raman Spectrum and its Behaviour at the Critical Point. G. Placzek and W. R. van Wijk.** *Zeits. f. Physik*, 70. 3–4, *pp*. 287–292, *June* 27, 1931.—The origin of the continuous background in the scattered spectrum from fluids is discussed with relation to the effects due to fluorescence, rotational Raman effect and that due to the vibration of molecular complexes. The latter should increase considerably near the critical point at which a binary mixture becomes homogeneous. Experiments on intensity and polarisation carried out in the region of opalescence confirm this conclusion. J. H. A.

**3835. Raman Effect in Gases. P. Daure and A. Kastler.** *Comptes Rendus*, 192. *pp*. 1721–1723, *June* 29, 1931.—The effect excited by the 4358·3, 4046·7 and 3650·1 lines of mercury in the gases $H_2$, $C_2H_2$, $(CN)_2$ and $H_2O$ at about atmospheric pressure have been recorded with exposures of 50 to 70 hours. The observed displacements are (1) for $H_2$— 355, 588, 819, 1040 and 4159 cm.$^{-1}$; (2) for $C_2H_2$— 1978 and 3373 cm.$^{-1}$; (3) for $(CN)_2$— 2330 cm.$^{-1}$, and for saturated water vapour at 130°— 3655 cm$^{-1}$. The last-named substance gives a fine line, while the liquid gives a diffuse band around 3400 cm.$^{-1}$, agreeing with direct infra-red observations. F. S.

**3836. Chemistry and the Raman Effect. Sensitivity of Organic Spectrum Analysis. R. Lespieau, M. Bourguel and R. L. Wakeman.** *Comptes Rendus*, 193. *pp*. 238–240, *July* 27, 1931.—The Raman effect has been employed to detect ethylenic impurities in hydrocarbons of the cyclopropane type, by means of the line at about 1600 cm.$^{-1}$. Analysis by the microphotometric method of Chalonge and Lambert permits the detection of traces of $\beta$ or $\gamma$ ethylenic hydrocarbons, and further, since the intensity of the line is probably independent of the position of the double linking, the quantity of such impurity may be determined to within about 1·3 %. H. F. G.

**3837. Zeeman Effect in the H.F. Discharge. L. and E. Bloch, F. Esclangon and P. Lacroute.** *Comptes Rendus*, 192. *pp*. 1717–1720, *June* 29, 1931.—The use of the h.f. discharge has a number of advantages, including a decreased tendency to extinction in the magnetic field. Furthermore, it yields sharp lines when examined with a large concave grating in fields up to 25,000 gauss. Results are given for a number of visible mercury lines which show satisfactory agreement with theory. F. S.

**3838. Zeeman Effect with the Absorption Lines of Potassium Chromiselenate Crystals. K. Schnetzler.** *Ann. d. Physik*, 10. 3. *pp*. 373–392, *July* 11, 1931.—The transverse Zeeman effect with the sharp absorption doublet of potassium chromiselenate at 6710 Å. has been investigated at − 190° C. Although the crystals belong to the regular system, the effect varies considerably with the orientation of the crystal in the magnetic field. Under all circumstances the direction of polarisation is inclined towards the direction of the field. The total effect is the sum of two superimposed effects, *viz.*, a feebly modified doublet and a triplet type. At field strengths of about 10,000 gauss the former alone is apparent, and on increasing the field to 17,000 gauss the entire structure vanishes; with further increase of the field-strength the side components of the triplet appear and increase in strength, and the doublet reappears, until at 26,000 gauss the two effects are of approximately equal magnitude.

H. F. G.

**3839. Asymmetry Observed in the Stark Components of $H_a$. D. R. McRae.** *Roy. Soc., Proc.* 132. *pp.* 257–265, *July* 2, 1931.—A special grating having a very intense first order spectrum on one side has been used to resolve the Stark components of $H_a$. Asymmetry is observed in the displacements of the components. This asymmetry is found to be in general qualitative agreement with the calculations of Schlapp [see Abstract 3014 (1928)]. There are certain discrepancies, however, which have not been explained. An asymmetry in the relative intensities of the components has been observed. It is shown that altering the number of atoms in the initial states does not explain completely this asymmetry. Under the conditions of this experiment, the intensities of the components become symmetrical if the discharge is through He, Ne or Xe, in which traces of H exist. AUTHOR.

**3840. Industrial and Chemical Research with X-Rays of High Intensity and with Soft X-Rays. G. L. Clark and K. E. Corrigan.** *Indust. and Engin. Chem.* 23. *pp.* 815–820, *July*, 1931.—A description of the uses of hard and soft X-rays in industrial and chemical research. Details of suitable apparatus are given. F. J. W.

**3841. Resolving Power Attainable in X-Ray Spectroscopy by Photographic Methods. S. K. Allison.** *Phys. Rev.* 38. *pp.* 203–211, *July* 15, 1931.—If $w_c$, the (half) range of glancing angle over which a crystal will reflect monochromatic X-rays, has been determined by the double-spectrometer method, it is possible to calculate what resolving power is attainable from this crystal by photographic methods. Equations are set up giving the resolving power in terms of $a$, the slit-width, and R, the distance from slit to photographic plate. Some results are: (1) No appreciable increase in resolving power is attainable by making $a/2R < \frac{1}{4}w_c$. (2) If $a/2R > 3w_c$ the resolving power does not involve $w_c$. (3) The resolving power attainable in the first order is $1/2^{1/2}$ of that attainable in a double spectrometer with crystals of equal perfection. Equations are also derived by which observed line widths in photographic spectrometers may be corrected for slit and crystal diffraction pattern effects. The results are applied to recent experimental results with photographic spectrometers, and it is shown that the width of $MoK\alpha_1$ observed photographically is considerably greater than the values obtained by the double spectrometer. AUTHOR.

**3842. Precision X-Ray Spectrometer and the Wave-Lengths of Mo $K\alpha_1$. A. H. Compton.** *Rev. Sci. Instruments*, 2. *pp.* 365–376, *July*, 1931.—An X-ray spectrometer was designed with the first crystal mounted on an arm supported by the frame of the spectrometer, and with the second crystal mounted on the central table of the instrument, whose position is read from a precision circle. The ionisation chamber, of 28 cc. capacity, filled with krypton, is on an arm whose position is read by a second precision circle. The instrument was built by the Société Genevoise de Physique. The first crystal was adjusted to throw the K$\alpha_1$ line of molybdenum over the main axis of the spectrometer, and measurements were made with the second crystal in the (1, − 1), (1, + 1), (1, − 4) and (1, + 4) positions (Allison's notation). The reflection maxima from calcite (corrected to 18° C.) occur at $\theta_1 = 6°42'35''\cdot5$ and $\theta_4 = 27°51'33''\cdot0$ with a probable error of $0''\cdot25$ due chiefly to errors in reading the circle. Using an apparent grating space for the first order of 3·02904 Å. at 18° C., we get $\lambda = 707\cdot830 \pm 0\cdot002$ mÅ. Larsson obtained $707\cdot831 \pm 0\cdot003$ mÅ. using Siegbahn's photographic method. Comparison of $\theta_1$ and $\theta_4$ gives for the index of refraction in calcite, $1 - \mu = (2\cdot10 \pm 0\cdot15) \times 10^{-6}$, as compared with Hatler's value of $(2\cdot04 \pm 0\cdot09) \times 10^{-6}$. AUTHOR.

**3843. Effect of Chemical Combination on the X-Ray Spectra of Copper. E. A. Owen and T. E. Williams.** *Roy. Soc., Proc.* 132. *pp.* 282–295, *July* 2, 1931.—The K$\alpha_1\alpha_2$ doublet of copper has been measured for copper in the form of its oxides and in a number of intermetallic compounds. In no case was there any change in the wave-length of the K$\alpha_1$ line or in the separation of the doublet. The results are not satisfactory for the oxides since they were probably completely decomposed by the electronic bombardment. The positions of the K absorption edges in the above compounds, together with a number of inorganic cupric and cuprous salts, have also been determined. The cupric salts and cupric oxide showed a a shift of the absorption edge to shorter wave-lengths of about 1·1 X.U. The intermetallic compounds and cuprous salts showed no shift, and it is therefore concluded that copper in its intermetallic compounds is in the cuprous state. F. J. W.

**3844. Influence of Temperature on the K-Absorption of Iron. J. D. Hanawalt.** *Zeits. f. Physik*, 70. 5–6. *pp.* 293–305, *July* 6, 1931.—The X-ray absorption spectrum of iron is investigated under high dispersion at high temperatures. The secondary structure occurring at 20° C. on the short wave-length side of the K-edge becomes less pronounced as the temperature rises, and has almost disappeared at 850° C. The position of the main edge is not altered by change of temperature, but the increase from 20° to 600° C. is attended by a movement of the secondary edges about 1·8 % towards it. These facts, as well as the magnitude of the separation between the secondary edges, are in agreement with a proposition of Kronig [see Abstract 3846 (1931)] that the energy of the electron at the end of the absorption process must lie within the permitted zones which are formed by its motion in the periodic field of the metal lattice. The results obtained earlier on the difference between the secondary radiation of mon- and polyatomic gases and of solids is again reviewed shortly. C. B. A.

**3845. Determination of the X-Ray Absorption Coefficients of Copper and Zinc in the Neighbourhood of the K-Absorption Edges. D. Coster and J. Veldkamp.** *Zeits. f. Physik*, 70. 5–6. *pp.* 306–316, *July* 6, 1931.—The variation in the X-ray absorption coefficients is measured in the region of fine structure of the K-edges of Cu and Zn. The variation is found to be in Cu at most 13 %, in Zn less than 7 %. This difference is explained, with reference to the work of Kronig [see following Abstract], through the difference in the melting-points of the two metals. C. B. A.

**3846. Theory of Fine Structure in X-Ray Absorption Spectra. R. de L. Kronig.** *Zeits. f. Physik*, 70. 5–6. *pp.* 317–323, *July* 6, 1931.—The occurrence of a resolved secondary structure in the K-absorption bands of crystals and metals in the solid state is related to the fact that the energy spectrum of an electron moving in a determined direction through a periodic potential field consists of permitted and forbidden zones of finite width. This also explains the influence of temperature on the secondary structure, investigated by Hanawalt [see Abstract 3844 (1931)]. With the help of a simple model, it is shown why such secondary structure occurs not only in crystals consisting of a large number of atoms, but also in polyatomic molecules, while it is absent in isolated atoms. C. B. A.

**3847. Intense Monochromatic X-Rays Obtained from Ordinary Tubes without Spectroscopic Apparatus. H. Küstner.** *Zeits. f. Physik*, 70. 5–6. *pp.* 324–347, *July* 6, 1931.—By means of a difference method the characteristic secondary radiation of an element can be separated from the scattered radiation which it emits under the influence of the exciting X-rays. By selective filtering, the K$\alpha\alpha'$ doublet of the elements is separated almost alone. In this way radiation is obtained which is about five times as monochromatic as that given by the best spectral monochromators. It has a surprisingly high intensity, which can easily be increased up to forty times that previously obtainable, over a wave-length range of 0·128 up to 2·5 Å. C. B. A.

**3848. Filter Technique in the Production of Monochromatic X-Rays. H. Küstner.** *Zeits. f. Physik*, 70. 7–8. *pp.* 468–491, *July* 14, 1931.—Further illustrations of the use of the method previously given by the author [see preceding Abstract] of obtaining a strong monochromatic X-ray beam of wave-lengths between 0·128 and 2·50 Å. The absorption coefficient of tin, the electron emission of tantalum and tungsten in relation to wave-length and the intensity relations in the Cu lines have here been determined with the help of this technique. J. E.

**3849. Photometry of Weak Blackening and Determination of X-Ray F-Values. J. Brentano.** *Zeits. f. Physik*, 70. 1–2. *pp.* 74–83, *June* 20, 1931.—The usual methods of spectrophotometry are best suited to the measurement of the blackening of well-exposed lines. A method is described, better suited to the measurement of weak blackening, in which the direct light through the photographic plate is cut out and the light scattered at an angle by the silver particles alone is allowed to fall on the photoelectric cell. For weak intensities the number of scattering particles is approximately proportional to the intensity. The blackening-scattering curve shows an approximate linearity to the X-ray intensity at weak illuminations. The method is applied to the relative estimation of X-ray F-values for heavy atoms in fine crystal powders. To eliminate absorption errors, comparison measurements are made by using powder mixtures in known proportions. Errors due to inequality in the size of the crystal particles are discussed. A. C. M.

## RADIOACTIVITY.

**3850. Measurement of Smallest Quantities of Radium. F. Paneth and W. Koeck.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 145–161, 1931.—A procedure has been worked out for the determination of radon which measures $10^{-13}$ curie to an accuracy of about 20 %. Full details are given of the apparatus employed and the procedure followed. By this method the radium content in a few grams of iron meteorites is determined by its average activity. This value combined with the He content of the same meteorite [see Abstract 1834 (1931)] provides a means of calculating the age of this iron meteorite. The method is also applicable for Ra determinations in a few grams of meteoric and terrestial rocks, examples of which are given. R. S. R.

**3851. Radon Content of the Free Air and its Vertical Distribution near the Earth's Surface. E. Schmid.** *Akad. Wiss. Wien., Ber.* 140. 2*a*. 1–2. *pp*. 27–48, 1931.—The vertical distribution of the radon in the free air and its dependence on meteorological factors were investigated by means of the coconut charcoal process. The results obtained confirm the observations and theory of W. Schmidt that the content of the radon in the free air decreases with increasing height above the earth's surface. From the observations made it was found that at 2 m. above the surface the mean content of radon $r_1$ was $101 \cdot 2 \,.\, 10^{-18}$ curie/cm.$^3$, the maximum being 216·4 and the minimum 34·3 in the same units. At the second point of indrawal of air the corresponding numbers were distinctly smaller, being in the mean 79·3, and the maximum and minimum 142·7 and 15·0 respectively. The smallest mean value obtained was at 50 m. height with $r_3 = 44 \cdot 0 \,.\, 10^{-18}$ curie/cm.$^3$, the maximum being 132·3 and the minimum 14·3. The ratio of maxima and minima is 1: 6 at 2 m. height and 1:10 at 13 m. and 50 m. Comparing the ratio of the radon content at 13 m. with that at 2 m. the ratio of the concentration of the radon is obtained, $r_2/r_1 = 78$ %. The maximum of 99 % is to the minimum value of 34 % in the ratio of 1 : 3. Comparing the results at 50 m. and 2 m. the considerably lower mean concentration ratio $r_3/r_1 = 43$ % is obtained. The maximum of 99 % is to the minimum of 16 % in the ratio 1: 6. The effects of various meteorological factors which were observed are in general agreement with those noted by previous investigators. J. J. S.

**3852. Separation of Polonium from Radioactive Salts of Lead. A. Karl.** *Akad. Wiss. Wien, Ber.* 140. 2*a*. 3–4. *pp*. 199–203, 1931.—Two methods are described which give a yield which is very close to the theoretically calculated activity. In the first the polonium is separated as an isomorphous polonium lead tellurate compound; the lead is removed from this as lead sulphate, and the tellurium separated in the metallic form, leaving the polonium alone in solution. In the second method colloidal platinum is employed as a temporary carrier for the polonium, with which it unites. The platinum carrying the polonium is rendered flocculent by irradiating it with a quartz-mercury lamp, and the polonium is distilled off from it in a current of hydrogen in a quartz tube, and collected on a copper electrode which is cooled with liquid air. H. N. A.

**3853. Artificial Disintegration of Elements: Relation between the Path of a Rapid Proton in Air and the Ionisation it Produces. L Leprince-Ringuet.** *Comptes Rendus,* 192. *pp.* 1543–1545, *June* 15, 1931. —Experiments were carried out to determine for rapid protons the curve analogous to that obtained by Bragg connecting the ionisation produced by $\alpha$-particles with their position in their trajectory. Use was made of the protons obtained from the artificial transmutation of aluminium by the $\alpha$-rays from polonium. Small ionisation chambers were located at different points in the path of the protons and in this way the increase of ionisation when the protons were reaching the end of their trajectories was determined. The curve thus obtained was verified by using other groups found in the velocity spectrum of the protons, and also by observations on protons liberated by impact of $\alpha$-particles on hydrogenated substances. The curve shows a very slow rise when the proton has still more than 10 cm. of air to traverse, but rises very rapidly in the last few cm. The maximum value of the ionisation produced in air by a proton is about a quarter of that for an $\alpha$-ray. Applications of the method to the study of the artificial transmutation of elements are briefly outlined. [See also following Abstract.] A. W.

**3854. Artificial Disintegration of Aluminium. M. de Broglie and L. Leprince-Ringuet.** *Comptes Rendus,* 193. *pp.* 132–133, *July* 20, 1931.—By the method previously described [see preceding Abstract] the "velocity" spectrum, as measured by the range, of the H-particles emitted by aluminium when bombarded by monokinetic groups of $\alpha$-particles of polonium has been determined. There is no continuous spectrum, $\alpha$-particles of maximum energy give groups of ranges about 30, 50 (feeble), and 60 cm.; the range diminishes as the energy of the $\alpha$-particles diminishes, the third group disappearing when the range is less than 2·7 cm. The groups have thus no fixed range, and there is no threshold value as with X-rays. [See also Abstracts 1303 and 2330 (1931).] C. A. S.

**3855. Atom Disintegration by Means of High Voltages. A. Brasch and F. Lange.** *Zeits. f. Physik,* 70. 1–2. *pp.* 10–37, *June* 20, 1931.—Researches were undertaken with the object of making use of the atmospheric electricity of thunderstorms as the source of very high voltage. Thus tensions with a minimum value of 8000 kV and a probable value of 15,000 kV were obtained. A vacuum discharge tube is described which permits of service at some thousand kV with quite considerable strengths of emission current, whose walls are secure from being pierced and that exhibit no limitation of tension. With the use of a collision generator as producer of tension intensive kathode and X-rays were developed which were at a potential of more than 2000 kV, and consequently might be called artificial $\beta$- and $\gamma$-rays. Arrangements for emission of kathode and $\gamma$-rays are explained, and the possibility of a further raising of the tension is discussed. J. J. S.

**3856. Analysis of the Long-Range $\alpha$-Particles from Radium C. (Lord) Rutherford, F. A. B. Ward and W. B. Lewis.** *Roy. Soc., Proc.* 131. *pp.* 684–703, *June* 3, 1931.—The method used was similar to that employed by Rutherford, Ward and Wynn-Williams for actinium C, with a differential ionisation chamber and the counting mechanism described by Wynn-Williams and Ward. About 20,000 long-range $\alpha$-particles are included in the final results for RaC, particular attention being directed to the complicated distribution curve for the $\alpha$-rays between the ranges 9 to 12 cm. in air. There is a predominant peak at 9 cm. range, a well-defined one at 7·8 cm., and between 9 and 12 cm. an approximately continuous distribution, with clear evidence of maxima. An analysis of the curve shows the presence of nine different groups, and a table gives the mean ranges, the velocities of the $\alpha$-particles in terms of that of group 1, the energy of an $\alpha$-particle in electron-volts $\times 10^{-6}$, and the relative number of $\alpha$-particles for each group. An attempt is made to trace a connection between the long-range $\alpha$-particles and the emission of $\gamma$-rays. It is concluded that the $\gamma$-rays arise from a transition of the $\alpha$-particle in an excited nucleus between two levels of different energies. Some of the stronger $\gamma$-rays have energies which can be accounted for in this way. H. N. A.

**3857. Magnetic Spectrum of $\alpha$-Rays of the Active Deposit of Actinon. (Mme.) P. Curie and S. Rosenblum.** *Comptes Rendus*, 193. *pp*. 33–34, *July* 6, 1931.—The magnetic spectrum as obtained by means of a specially active source [see *J. Chim. Phys.* 27. *p*. 1, 1930] and a field of 24,000 gauss confirms the complexity of the 5·5-cm. particles from actinon [see Abstract 528 (1931)]. The velocities of the rays, $\alpha$, $\alpha_1$, $\alpha_2$ of AcC, AcC″ and AcC′ are respectively as 1 : 0·973 : 1·062. C. A. S.

**3858. Number of Pairs of Ions Produced in Air by an $\alpha$-Particle of Polonium. Grégoire.** *Comptes Rendus*, 193. *pp*. 42–44, *July* 6, 1931.—The ratio $I/i$, where I is the ionisation current produced by a bundle of $\alpha$-particles for the solid angle $2\pi$, and $i$ the current due to the charge carried by them, for $\alpha$-particles of polonium is $0\cdot765 \times 10^5$. Assuming that the $\alpha$-particles are practically all doubly charged the number of pairs of ions ($= 2I/i$) is $(1\cdot53 \pm 0\cdot02) \times 10^5$. From this and other results [see Abstracts 859 (1929) and 499 (1930)] the number of $\alpha$-particles emitted by radium per gm. per sec. is $3\cdot56 \times 10^{10}$. C. A. S.

**3859. Secondary Radiation Liberated in Light Elements by $\alpha$-Rays. Adelina Deseyve.** *Akad. Wiss. Wien, Ber.* 139. *2a*. 9–10. *pp*. 521–534, 1930.—Using polonium as source of primary rays the five elements Mg, Al, Si, P and S were examined by the recoil method for secondary radiation. With minimum secondary absorption a number of secondary particles were observed which could be explained neither as reflected $\alpha$- nor as $\beta$-rays. These particles are in all probability H-particles liberated in the elements. Beyond the range of the reflected $\alpha$-rays were noticed, in the case of Mg, Al, Si and P, particles which likewise are to be identified with H-rays from atom disintegration. In the case of Mg, however, the effect is so small as to be uncertain. The disintegration of Al by $\alpha$-rays from polonium has been known since 1927. The ascertainment of similar disintegration of Si and P is new. J. J. S.

**3860. Absorption Method of Investigating the High-Velocity Limits of Continuous $\beta$-Ray Spectra. N. Feather.** *Cambridge Phil. Soc., Proc.* 27. *pp*. 430–444, *July* 31, 1931.—Measurements by the absorption method, that is by observing the intensities for gradually increasing thickness of absorber and noting the end point of the resulting curve, have been made in the cases of radium E, thorium C and radium C, and the maximum effective ranges have been found by the author and other observers. The upper limits of the continuous spectra are in these cases known from magnetic spectroscopy. It appears that, within limits of

accuracy of a few per cent., the maximum effective range is in each case the same as the extrapolated range corresponding to the particles of highest energy present in the beam. This close agreement is shown to be due to particular circumstances, and a detailed analysis is made by the author of the various factors which conspire to produce this result. It is shown that caution is still necessary in any statement concerning the absolute nature of the high-energy limits of continuous $\beta$-ray spectra.
H. N. A.

**3861. Eve's Constant. A. W. Reitz.** *Zeits. f. Physik*, 69. 3-4. *pp*. 259-286, *May* 1, 1931.—The value of Eve's constant K, at 0° C. and 76 cm., was determined and found to be $4 \cdot 3 \times 10^9$, in agreement with Eve's value. Investigations were carried out on secondary electrons liberated in Al, Zn and Pb by RaC $\gamma$-rays, and their absorbability examined. The influence which the surrounding circumstances exert in ionisation measurements in consequence of the secondary radiation was also investigated. In conclusion a short account is given of the results obtained in high aeroplane flights for the investigation of the distribution of intensity of cosmic radiation and its variation with height. J. J. S.

**3862. Scattering of H-Rays in Hydrogen. C. Gerthsen.** *Ann. d. Physik*, 9. 7. *pp*. 769-786, *June* 10, 1931.—The individual scattering of H-rays in hydrogen was measured by the author in the angular region of 15° to 35°. The observed angular distribution shows a course which deviates from that which would be expected according to the classical theory, and, especially in the case of the scattering under greater angles, is in good agreement with the wave-mechanics theory developed by Mott.
J. J. S.

**3863. Valve Amplifier and the Detection of Isolated Corpuscles. L. Leprince-Ringuet.** *Annales des P.T.T.* 20. *pp*. 480-492, *June*, 1931.—Describes an amplifier designed in de Broglie's laboratory, which makes it possible to detect the passage of an H-particle through 1 cm. of air. This corresponds to a charge of more than $10^{-16}$ coulomb arriving at the first grid in a time of the order of 0·01 sec. The amplified current is proportional to the incident charge. The form of ionisation chamber made use of is described, together with the precautions which are necessary to obtain good results. H. N. A.

**3864. New Method for Counting Coincidences Automatically. J. M. Hummel.** *Zeits. f. Physik*, 70. 11-12. *pp*. 765-781, *July* 29, 1931.—A scheme of connections is described by means of which coincident impulses, taking place in two or more counter tubes, can be directly measured and automatically registered. The counter tubes are connected in series in a common circuit, the tube of the first one being joined to the wire of the second, and so on for the others, if any. The relations necessary for the different resistances and capacity required in the joint circuit are explained, and the method of working is described. Only impulses which occur simultaneously in the different counter tubes are recorded. The advantages and disadvantages of the method are discussed. There are no triode valves in the circuit such as are used in other methods. This in some ways makes matters much simpler and more convenient. H. N. A.

# HEAT.

**3865. Thermal Conductivity of Metal Wires. W. G. Kannuluik.** *Roy. Soc., Proc.* 131. *pp.* 320–335, *May* 1, 1931.—In a previous paper the author described his use of the thermal method in measuring conduction in metals [see Abstract 1240 (1929)]. In the present case an electrical method was employed in determining the thermal conductivity, $\lambda$, of some metals in wire form. The method is applicable provided that the ratio of the lateral to the longitudinal heat loss from the wire is made small. When this is not the case $\lambda$ cannot be determined unless the surface emissivity is known independently. In a simple form of conductivity apparatus long thick wires were mounted, and no "end" corrections were necessary. A small lateral loss of heat by radiation, involving a correction in $\lambda$ of about 1 %, was allowed for by calculation. The thermal conductivity $\lambda$, the electrical conductivity $\kappa$ and the Lorenz coefficient $\lambda/\kappa T$, T being the temperature in °K, are given in a table for silver, gold, molybdenum and tungsten. J. J. S.

**3866. Method of Measuring Thermal Conductivity of Glass. R. Reulos.** *Rev. d'Optique,* 10. *pp.* 266–272, *June–July,* 1931.—The conductivity of poor conductors of heat may be found by comparison with a substance of known conductivity. The two substances are in the form of discs placed in contact, and the same flow of heat passes through them in series. The conductivities are in the inverse ratio of the two temperature gradients. In practice the discs are enclosed and kept separate by three copper discs connected to thermocouples, and the standard substance was water. Some examples of measurement are given. G. E. A.

**3867. Special Refractories for Use at High Temperatures. W. H. Swanger and F. R. Caldwell.** *Bureau of Standards, J. of Research,* 6. *pp.* 1131–1141, *June,* 1931.—Refractories for the melting of pure metals up to temperatures from 1700° to 2200° C. are described. Details are elaborated for the preparation of crucibles, etc., from the oxides of Th, Mg, Zr and Be. Thorium oxide, melting point above 3000° C., is the most refractory of the four. Magnesium oxide crucibles were not satisfactory for very pure metals, but crucibles of the "C.P." grade of powdered magnesium oxide could be used without deleterious effects up to 2000° C. Sintered or commercial electrically-fused zirconium oxide contains small amounts of silica and, unless the melting is done in air, up to temperatures of 2000° C. contamination results. If available commercially, beryllium oxide might be a satisfactory refractory at high temperatures. S. G. B.

**3868. Kelvin Scale Temperature of Freezing Water. F. G. Keyes.** *Am. Acad., Proc.* 66. 9. *pp.* 349–355, *June,* 1931.—The calculation of the thermodynamic temperature of the ice point involves, among other things, the calculation of $\int \lambda dT/T^2$ from $T_0$ to $T_{100}$, where T is the thermodynamic temperature, the subscripts are °C. and $\lambda$ is a measure of the "free expansion" effect, the isothermal rate of change of internal energy with volume. The present paper shows an improved method of calculating this integral from the numerical data, and the final result from Roebuck's measurements on air is taken to be $T_0 = 273 \cdot 135°$ K. J. H. A.

**3869. Freezing Point of Platinum. W. F. Roeser, F. R. Caldwell and H. T. Wensel.** *Bureau of Standards, J. of Research,* 6. *pp.* 1119–1129, *June,* 1931.—In determining the freezing point of platinum on the International Temperature Scale, measurements were made of the ratio of brightness of black bodies maintained at the freezing points of gold and platinum. The black bodies used were hollow enclosures of fused thorium oxide immersed in the molten metals. Observations were made during the freezing of the metals. Two optical pyrometers were used and observations were obtained on two separate lots of pure platinum by three observers. The metals were heated in air using a h.f. induction furnace to secure automatic stirring of the freezing metals and to avoid contamination from furnace windings. The freezing point was found to be 1773·5° C. AUTHORS.

**3870. Black Body at the Melting Point of Palladium. S. Nikitine.** *J. de Physique et le Radium,* 2. *pp.* 205–226, *July,* 1931.—A black body has been designed which can be inserted into a molybdenum furnace, and the melting point of palladium measured by the wire method. The results are very concordant with those previously obtained by the same author, using the tube method with considerable mechanical tension. The result given is 1830° K. J. H. A.

**3871. Precision Cryoscopy. Freezing Point Depressions of Potassium Cobalticyanide and Potassium Ferricyanide. C. Robertson and V. K. la Mer.** *J. Phys. Chem.* 35. *pp.* 1953–1984, *July,* 1931.—Sources of error in the determination of freezing points in very dilute aqueous solutions are critically reviewed and evaluated, and methods of minimising such errors are discussed. Details are given of the construction, operation and specific errors of a modified form of apparatus which yields results with a maximum error of $1 \times 10^{-5}$° C. Measurements with 0·005–0·0003 M solutions of potassium cobalticyanide and potassium ferricyanide confirm Gronwall, la Mer and Sandved's extension of the Debye-Hückel theory as regards the form of the osmotic deviation function. A proposed entirely new design of apparatus for freezing point measurements is described. H. F. G.

**3872. Extraction of Krypton and Xenon from Liquid Air Residues. Determination of Certain Physical Constants of Krypton and Xenon. F. J. Allen and R. B. Moore.** *Am. Chem. Soc., J.* 53. *pp.* 2512–2527, *July,* 1931.—A new method of handling liquid air residues from compressed gas cylinders is described, which permits the bulk of the inert gases present in the liquid air residues to be obtained without the use of large gasometers and otherwise affords many advantages in manipulation. New values are reported for temperatures and pressures at the triple points of krypton and xenon, whilst studies of their vapour pressures indicate the accepted values of the boiling points to be in error, and new values are recorded. H. H. Ho.

**3873. Change from Liquid Helium I to Liquid Helium II under Pressure. W. H. Keesom and K. Clusius.** *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 605–609, 1931. *Comm. No.* 216*b from the Phys. Lab., Leiden.*—It is not as yet certain whether there is a sudden change from one form to the other at a definite temperature, which depends on the pressure, or whether the rate of change is simply a maximum at the temperature in question. For the present the authors have assumed the latter to be the case, and they have found the following relations to exist between the pressure in atmospheres and the temperature of maximum rate of change: 0·050$^{9}$, 2·190° K.; 6·39, 2·106° K.; 11·13, 2·049° K. 16·09, 1·973° K.; 23·60, 1·860° K. If the resulting curve in the pressure-temperature diagram, which is nearly a straight line, is produced upwards, it cuts the curve of melting points of helium at varying pressures, at 30 atmospheres and about 1·75° K. H. N. A.

**3874. Latent Heat of Fusion and Density of Helium between 15° and 20° K. F. Simon and F. Steckel.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 737–744, 1931.—The purpose of the study was to seek for evidence of a critical point between liquid and solid, expected by the authors from several lines of argument. The density of the liquid was found to be 0·31, 0·32 and 0·35 gm. per c.c. at temperatures of 14·9°, 17·0° and 20·4° K. under the pressures 1121, 1440 and 1864 kg. per sq. cm. At the same temperatures and pressures, the latent heat of fusion is 24, 40 and 37 gm. cal. per atomic weight. J. H. A.

**3875. Water Content of Benzene. A. W. C. Menzies.** *J. Phys. Chem.* 35. *pp.* 1655–1659, *June*, 1931.—Two methods are described for examining the water content of benzene vapour at the boiling point. If one-fourth of a sample of ordinary benzene, containing water, is distilled off at atmospheric pressure, the remainder contains less water than would affect the normal boiling point by 0·1°. It is observed that this bears upon work with intensively desiccated benzene. A simple indirect method of measuring dissociation pressures of salt hydrates is also described. It is also noted that benzene dried by sodium and transferred to a glass vessel does not contain more water than would alter the normal boiling point by 0·01°. J. K.

**3876. Reflection of Vapour Molecules at a Liquid Surface. T. Alty.** *Roy. Soc., Proc.* 131. *pp.* 554–564, *June* 3, 1931.—It is pointed out that the following equation $m = 14\cdot63 Ps/\sqrt{T_s}$ gm./sq. cm./min., where $m$ is the mass of molecules leaving unit area of a liquid per min. and also the mass of molecules striking unit area of liquid per min. from the saturated vapour, and $Ps$ is the saturated vapour pressure in mm. of Hg at the surface temperature $T_s^\circ$ Abs., has not so far been verified for water. This equation is derived from the kinetic theory of gases and the equation is only valid if there is no reflection of vapour molecules at the surface so that every incident molecule enters the liquid. From the experimental results obtained it is shown that there must be very pronounced reflection of water-vapour molecules at the liquid surface. J. K.

**3877. Rate of Evaporation of Crystals. G. Tammann and K. L. Dreyer.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 1–18, 1931.—The rate of evaporation of crystals increases with the vapour-pressure excess and increases to a limiting value dependent on the temperature, thus differing from liquids, for which no limiting value is known. The rate of evaporation changes with pressure in the same manner as electron emission with voltage, whilst both phenomena show the same temperature effects. J. H. A.

**3878. Lattice Energies and Heats of Sublimation of Alkali Halides. K. Fajans and E. Schwartz.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 717–730, 1931.—Further consideration of results obtained during the past ten years shows that, in checking the values of the lattice energy by means of the heats of solution, the use of the single exponent $n = 9$ of the repulsion potential for all alkali halides leads to disparities as great as 15 k. cal. While the explanation of the anomalies in the gradation of the boiling points and heats of sublimation of the alkali halides by the influence of the relative magnitudes of the ions fails in the cases of RbF and CsF, the influence of deformation of the ions in the vapour molecule is in qualitative agreement also with the facts concerning these salts. As regards a quantitative measure of the extent to which the sublimation energy of the alkali halides is influenced by the deformation of the ions or by the radius-ratio, calculation furnishes no definite conclusion. The apparent quantitative agreement between the results of calculations based on the assumption that $n = 9$ and the experimental data is due partly to comparison of data which do not correspond and partly by compensation of various inaccuracies in the assumptions made, this being either accidental or caused by suitable choice of unknown parameters. T. H. P.

**3879. P-V-T Relations of Ammonium Chloride and Bromide, and in Particular the Effect of Pressure on the Volume Anomalies. P. W. Bridgman.** *Phys. Rev.* 38. *pp.* 182–191, *July* 1, 1931.—It is known that ammonium chloride and bromide show abnormally high specific heats between − 30° and − 40° C., although the crystal structure does not alter. The thermal expansions also show anomalies at atmospheric pressure, and the whole characteristic surface has therefore been explored, at temperatures of 0°, 30° and 75° C. for the chloride and at − 72°, 0° and 75° C. for the bromide, the pressure range extending to 12,000 atmospheres, except at − 72° C. where it was 7500 atmospheres. The displacements are in the directions to be expected, and the order of magnitude of the latent heat of the phenomenon is estimated. J. H. A.

**3880. Behaviour of Ideal Gases at the Highest Temperatures. K. Bennewitz.** *Zeits. f. Physik,* 70. 7–8. *pp.* 429–443, *July* 14, 1931.—A mathematical paper giving a relativistic treatment of a Bose–Einstein gas. This is shown to be equivalent to a photon gas at infinitely high temperatures. The energy distribution function is calculated and special cases are considered. A formula for the total energy is obtained, and at high temperatures gives values differing from those deduced from Stefan's law and classical theory only by a numerical factor 2. A qualitative picture of the states and processes is given. N. D.

**3881. Molecular Forces. Derivation of the van der Waals Expression $a/v^2$. A. Eucken.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 432–436, 1931.—An elementary kinetic presentation of the theory, which does not involve the assumption that the field of force is large compared with the molecular diameter. The clustering of molecules at low temperatures is also considered. J. H. A.

**3882. Theorem of Corresponding States and the New Theory of the van der Waals Forces. K. Wohl.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 807–816, 1931.—A theory is outlined which differs from that of London and is claimed to have a wider basis and more general application. J. H. A.

**3883. Reversion of Physical Laws. E. Schrödinger.** *Preuss. Akad. Wiss. Berlin, Ber.* 9. *pp.* 144–153, 1931.—If the probability for the occurrence of a diffusing particle at a point is given for two different moments of time, then this probability for an intervening moment is the product of a solution of the equation of heat-conduction and its adjoint. Thence it can be directly inferred that a state which has come about spontaneously, and which is observed in a system in thermodynamic equilibrium, is almost certainly produced by the image in time of a "normal" process. This suggests an interesting analogy to wave-mechanics. H. L. B.

**3884. Quantum Theory of the Equation of State. J. C. Slater.** *Phys. Rev.* 38. *pp.* 237–242, *July* 15, 1931.—It is shown that the quantum theory analogue to the quantity $e^{-\epsilon_{pot}/kT}$ giving the distribution in coordinates of systems at temperature T can be easily set up. Similarly in quantum theory the computation of the free energy can be reduced to the integration of such a function over the coordinates, as in classical theory. The result is applied to a qualitative discussion of the equation of state of an imperfect gas, showing that He and $H_2$ may be expected to show quantum effects in their equations of state, but hardly any other gases. AUTHOR.

**3885. Chemical Constant of Chlorine Vapour and Entropy of Crystalline Chlorine. T. E. Stern.** *Roy. Soc., Proc.* 131. *pp.* 339–354, *May* 1, 1931.—The author has recently calculated [see Abstract 1974 (1931)] the vapour pressure of hydrogen crystals using the Einstein–Bose statistics for the gaseous phase. In this paper similar methods are applied to chlorine. Owing to the existence of two isotopes of Cl, five gases have to be dealt with instead of two. Moreover, it is almost certain that H molecules can rotate freely in the crystals of hydrogen but Cl molecules cannot rotate in crystals of chlorine. Chlorine at ordinary temperatures is considered as consisting of three types of molecules denoted by A, B and C. By statistical mechanics investigation is made of the composition of chlorine gas—the relative numbers of molecules of the different sorts present in the ordinary gas. Rigorous investigation is made, and it is found that the composition of chlorine is independent of the magnitudes of the nuclear spins. The method applied in calculating the vapour pressure of chlorine crystals is general and applicable also to other diatomic homopolar gases which may consist of two or more isotopes. The nuclear angular momentum of $Cl^{35}$ (type 1) is denoted by $n_1k/2\pi$ and that of $Cl^{37}$ (type 2) by $n_2k/2\pi$, where $k$ is Planck's constant. The values of $n_1$ and $n_2$ are without effect on the vapour pressure. A value is found for the chemical constant of chlorine vapour, which is in satisfactory agreement with experiment. By statistical mechanics the entropy of crystalline chlorine at the absolute zero of temperature is calculated. Here $n_1$ and $n_2$ are important. J. J. S.

**3886. Generalised Thermodynamics and Theory of Fluctuations. G. N. Lewis.** *Am. Chem. Soc., J.* 53. *pp.* 2578–2588, *July*, 1931.—By a method which differs radically from the methods used either in classical thermodynamics or in statistical mechanics, it is shown that the laws of thermodynamics and the laws of fluctuations constitute together a generalised thermodynamics which is derivable from a single cardinal postulate. It is claimed, moreover, that this postulate is the first really valid statement of the second law of thermodynamics. AUTHOR.

## SOUND.

**3887. Transformation of Luminous Intensities to Sound Intensities. G. Fournier.** *Comptes Rendus*, 192. *pp*. 1547–1548, *June* 15, 1931.—The copper-oxide photoelectric piles prepared by P. Auger, under a p.d. of a fraction of a volt, furnish a current of which the intensity, proportional to the received illumination, exceeds 0·6 mA in full sunlight, for an active surface of less than 3 cm.$^2$. These piles, which are very robust, have been utilised in apparatus capable of giving to persons totally blind some indication of the luminous qualities of the objects surrounding them, by means of sound sensations. The apparatus comprises the photoelectric pile, formed of four discoid elements, 16 mm. dia., mounted in tension, an interrupter vibrating at an audio-frequency and a telephone earpiece. With this apparatus, blind people can easily distinguish the direction of windows or similar light openings, or the position of a piece of white paper on a table, and can discriminate between white, grey or black clothing of persons in front of the pile. Applications of three piles with colour filters for colour analysis are being studied, and also an optical system to permit the deciphering of simple designs or of Morse characters. A. W.

**3888. Kirchhoff Constant and its Variation with Temperature. F. Rechel.** *Ann. d. Physik*, 10. 1. *pp*. 1–14, *June* 24, 1931.—A previous investigation of the constant for air [see Abstract 1611 (1931)] is extended to other gases. Modifications of the experimental method are described, and results are given for air, $CO_2$ and $NH_3$, the values being reduced to those for a uniform frequency of 1600. All the graphs of $\gamma$ against temperature show a rise from about 0° C., rapid at first, but tailing off to a slow uniform increase of $\gamma$ with rise of temperature from about 150° C. upwards. In this respect all the graphs are more or less parallel to, but higher than, the theoretical curves for $\gamma$. G. E. A.

**3889. Transverse Vibrations of Strings. R. Serini.** *Accad. Lincei, Atti*, 13. *pp*. 354–357, *March* 1, 1931.—General solution of the problem of vibrations of a cord, fixed at one end, with resistance. A. D.

**3890. Solution of the Equation of the Vibrating String. W. A. Versluys.** *K. Akad. Amsterdam, Proc.* 34. 5. *pp*. 692–698, 1931.—The solution of the equation $\frac{\partial^2 y}{\partial t^2} - \frac{\partial^2 y}{\partial x^2} = f(x, t)$ expresses $y$ in the form of a series of functions of $x$, $t$, and $l$ the length of the string. G. E. A.

**3891. Vibration of a Plate due to the Surrounding Medium. Z. Carrière.** *J. de Physique et le Radium*, 2. *pp*. 165–188, *June*, 1931.—When a plate is set in vibration by the surrounding air, the amplitude varies according to the difference between the natural frequency of the plate and the actual frequency. There is a change of natural frequency with amplitude. This explains the sudden changes of amplitude in cases where the frequency diminishes when the amplitude increases. Long plates vibrate in phase with the air, short plates in opposition. The author describes a detailed investigation of the disturbance and mode of vibration of the air in the neighbourhood of the plate. J. W. T. W.

**3892. Formation of Sand Figures on a Vibrating Plate. E. N. da C. Andrade and D. H. Smith.** *Phys. Soc., Proc.* 43. *pp.* 405–411, *July*, 1931.—The conditions governing the movement of small particles on a vibrating surface are investigated experimentally and theoretically, close agreement being obtained. An arrangement by means of which the formation of the Chladni sand figures can be studied in detail, and projected on a screen, is described. AUTHORS.

**3893. Edge Tones. E. G. Richardson.** *Phys. Soc., Proc.* 43. *pp.* 394–404; *Disc.*, 404, *July*, 1931.—If a fluid leaves an orifice as a jet and strikes an edge, two vortex streets are formed on each side of the wake, and maintain the jet in pendulation at a definite frequency. The tones so produced are examined from theoretical and experimental standpoints, and relations connecting the frequency with (*a*) velocity, (*b*) distance from orifice to edge, (*c*) width of orifice, (*d*) form of the orifice, are tested. It is shown that all the features of the phenomena can be explained in terms of the hydrodynamics of a viscous fluid, without postulating compressibility in addition. AUTHOR.

**3894. Measurement of Noise. G. W. C. Kaye.** *Roy. Inst., Proc. Advanced proof received July*, 1931. *Nature*, 128. *pp.* 253–264, *Aug.* 15, 1931. *Supplement.*—A popular account of the incidence of noise in everyday life and its effects on human beings. Among definitions of noise, the legal one runs: an excessive, offensive, persistent or startling sound. The frequency and intensity ranges of the ear are considered, also the processes of matching and masking sounds. The decibel unit of loudness is such that if two intensities are in the ratio $r$ : 1, they differ in loudness by 10 log $r$ decibels. The practical measurement of noise may involve the gauging of its energy content, say, in microwatts/cm.$^2$, the analysis of the noise into its spectrum of frequency components, the determination of the wave-form of the noise or the aural measurement of its loudness. For the comparison of the sound under test with a standard sound, three forms of audiometer are described in their general lay-out, also Davis' simple tuning-fork audiometer. Many interesting results of noise measurement are given. The tone used in ordinary conversation has an intensity of about 50 db and an average motor horn has, at 20 ft., a loudness of about 80 db. Finally, the question of protection from noise and the noise-proofing properties of various materials are discussed. G. E. A.

**3895. Concave Ultrasonic Diffraction Grating. G. E. Thompson.** *Rev. Sci. Instruments*, 2. *pp.* 332–335, *June*, 1931.—The grating is made of brass; the concave spherical surface has a radius of curvature of 30·5 cm. Parallel slots are milled in the surface, the teeth having the same width as the slots, 0·794 mm. Diameter of slotted surface 9·0 cm. An electrically-oscillating quartz crystal is employed as generator of h.f. acoustic waves; rather thin crystals can be used, so that no slit is required. Source, grating and receiver are mounted in a manner similar to that used for an optical Rowland concave grating, and observations of the angles of diffraction are made with three different wave-lengths. The values of the wave-lengths determined in this way agree fairly well with those obtained by means of an interferometer. The observations are regarded as preliminary, and it is expected that the results will be improved when a permanent mounting has been provided for the grating. H. N. A.

# ELECTRICITY AND MAGNETISM.

## ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

**3896. Multipolar Influence Machines. H. Wommelsdorf.** *Ann. d. Physik*, 9. 3. *pp.* 265–272, *May* 2, 1931.—The original inventor of the influence machine, W. Holtz, himself gave an account of a multipolar arrangement of such machines, *i.e.*, one which allows the rotating disc to work upon four or more fields or poles instead of two. Since Holtz's time, this suggestion fell into oblivion for a period, but many devices have later been brought forward, and some new ones are described in this paper. The new idea which lies at the root of these new arragements is the same, and contained in the principle that on one and the same disc (or influencing rotating body) both self-exciting poles and those excited from the outside can be made to work, so that the latter are simultaneously excited by the first and are maintained in excitation. J. J. S.

**3897. Pyroelectricity. A. J. P. Martin.** *Phil. Mag.* 22. *pp.* 519–523, *June*, 1931.—A method of detecting pyroelectricity depending upon the attraction between a charged crystal and a metallic conductor, the charge being developed by cooling the crystal in liquid air. Results for a number of crystals are given, attention being drawn to dioptase which, though placed in a centro-symmetrical class, yet shows definite pyroelectricity. A. D.

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**3898. Conductivities and Dielectric Constants of Glucose and Boron-Trioxide Glasses. S. B. Thomas.** *J. Phys. Chem.* 35. *pp.* 2103–2111, *July*, 1931.—The electrical conductivity and dielectric constant curves of glucose have been determined throughout the temperature interval in which this material changes from a viscous liquid to a hard glass. The results obtained indicate that both electrical conductivities and dielectric constants are functions of the viscosity, and that there is no discontinuity in these properties between the liquid and glassy states. Measurements of the conductivities and dielectric constants of a series of boron trioxide-sodium borate solutions support the conclusions arrived at in the case of glucose. AUTHOR.

**3899. Dipole Moments of Some Inorganic Compounds and Determination of Atomic Distances and Atomic Radii. E. Bergmann and L. Engel.** *Phys. Zeits.* 32. *pp.* 507–509, *July* 1, 1931.—Data are given for certain halogen inorganic compounds, and the following conclusions drawn: For compounds of the type $AX_3$, the dipole moment shows that they consist of 3-sided pyramids. The polarisability increases with increase of radius of the central atom and decreases with increase of halogen radius. For compounds of the type $AX_4$, the dipole moment of tin tetrachloride indicates a four-sided pyramid, but silicon and titanuim tetrachlorides with zero moments have the tetrahedral form of carbon tetrachloride. For the type $AX_5$, the dipole moments of antimony pentachloride and iron pentacarbonyl indicate the regular pentagon with the central atom at the centre of gravity. Phosphorus pentachloride and tantalum pentafluoride have the tetragonal crystal structure. An

equation has been derived which enables the atomic distances to be calculated for the compounds $AX_3$, which possess a finite dipole moment; and it can be adapted to the types $AX_4$, $AX_2$ and AX. Various data of former investigators for chlorides, bromides and hydrides are corrected.
H. H. Ho.

**3900. Atmospheric Electricity. Field and Ionic Distribution in a Gas Traversed by a Current and Containing Electricity Carriers of Little Mobility. J. Scholz.** *Akad. Wiss. Wien, Ber.* 140. *2a.* 1–2. *pp.* 49–66, 1931.—J. J. Thomson calculated with simplifying assumptions the field and ionic distribution in a plate condenser traversed by a current which is filled by gas which contains normal (easily moving) ions. Schweidler treated this case with consideration of atmospheric-electric conditions, and calculated the " electrode action " of the vertical conduction current. On the basis of these previous discussions the author deals with the following problem: There is given a horizontal infinite plane over which there is air of normal density at rest which is permanently ionised. The strength of ionisation is constant as to time and space. In each c.c. of this air N nuclei are contained, of which portions $N_1$ and $N_2$ carry positive and negative charges respectively (slightly mobile electricity carriers, large ions), whilst the remainder $N_0$ is uncharged. The initial space charge in the air is zero. The conducting surface is charged so that an electric field exists. This charge is permanently maintained. In consequence of the field a current flows which consists of an upward current of + and a downward current of − ions. Since from the plate no + ions are given up to the air there occurs in the neighbourhood of the plate an impoverishment in + and an enrichment in − ions (electrode action) which causes the appearance of a negative space charge and therewith a decrease of the field upwards. After a certain time a stationary state is reached. The problem consists then in the calculation of the decrease of the field strength with height from its initial value $F_0$ to its limiting value $F_\infty$ in the stationary condition, as well as the change of the ionic density of the separate kinds of ion and the variation of space charge with height. This problem is treated mathematically with the use of some simplifying hypotheses. J. J. S.

**3901. Condensation Nuclei and Atmospheric Electric Elements. G. R. Wait.** *Terr. Mag.* 36. *pp.* 111–131, *June,* 1931.—Diurnal variation observations of the concentration of condensation nuclei in the atmosphere with certain atmospheric elements and electric phenomena are investigated. Curves are obtained for the various elements, and found to be somewhat similar. The curve for the rate of ionisation calculated from the linear recombination law agrees with one obtained from potential gradient and negative conductivity. Several mechanisms are considered to account for the potential gradient at Washington, and a promising one is found in the variation in height and in density of the local space charge. Effects at sea and at land stations are found to be similar, indicating a universal effect in a dust-free atmosphere, but which on land is modified by local pollution. H. M. B.

**3902. Action of the Earth's Magnetic Field on Penetrating Radiation. B. Rossi.** *Accad. Lincei, Atti,* 13. *pp.* 47–52, *Jan.* 4, 1931. *N. Cimento,* 8. *pp.* 85–97, *March,* 1931.—Referring to his experiments in which he confirmed Bothe and Kolhörster's results, which showed that even at sea-level there exists a penetrating ultra-$\gamma$ radiation [see Abstract 2336 (1931)], the author describes further researches made to test whether the penetrating radiation (cosmic radiation) is affected by the magnetic field of the earth. If the penetrating radiation reaches the limit of the atmosphere as a corpuscular radiation having an energy of some thousands of volt-electrons, the terrestrial magnetic field should give place to a strong dissymmetry in its distribution of intensity with respect to the plane of the magnetic meridian. Experiments carried out to put in evidence this dissymmetry gave a negative result. J. J. S.

**3903. Direction Measurements of Cosmic Radiation with a Counting Tube. L. Tuwim.** *Preuss. Akad. Wiss. Berlin, Ber.* 5. *pp.* 91–106, 1931.—Examples and measurements are given with various directions of the axis of the counting tube, and the subject is mathematically treated, beginning with the simplified case in which all cosmic radiation strikes the earth's surface at right angles, and produces collisions directly in the counting tube. J. J. S.

**3904. Determination of Intensity of Cosmic Ultra-Radiation by Aircraft Flights. A. W. Reitz.** *Akad. Wiss. Wien, Ber.* 139. 2a. 9–10. *pp.* 707–715, 1930.—From observations made in high flights in a Junker machine the author has obtained the following intensity distribution of the ultra-radiation with the height:

| Height (m.) | 2000 | 3000 | 4000 | 4500 | 5000 |
|---|---|---|---|---|---|
| Intensity (J) | 5·7 | 9·0 (8·4) | 14·7 (15·1) | (20·9) | 24·2 |

The figures in brackets are the mean results of four flights, the others the mean of the first two. The calculation of an absorption coefficient gave $\mu/\rho_{\text{air}} = 4\cdot 72\cdot 10^{-3}$ gm.$^{-1}$ cm.$^{2}$ J. J. S.

**3905. Exact Measurements of the Intensity of Cosmic Radiation. G. Hoffmann.** *Zeits. f. Physik*, 69. 11–12. *pp.* 703–718, *June* 13, 1931.—For the attainment of trustworthy results of the space and time variation of the ultra-radiation an exact measurement of the intensity is necessary. By counting tube methods a very great amount of numbering is required. Thus to reduce the mean error to 1 % it is necessary to count 10,000 excitations. By the ionisation method, on the contrary, this degree of accuracy can be attained without difficulty if a sufficient amount of gas is used, and if at the same time the electrometric measurement of charge is suitably refined. The author discusses and criticises various observations made by different investigators upon the variations of the intensity of cosmic rays. The experiments carried out with the large Zwilling apparatus are shown by curves and a strong meteorological influence on the soft radiation is shown. In the case of the band radiation there is noticeable next to the dependence on pressure of the air a direct or indirect influence of the sun. The problem of a proof free from objection of the possible existence of a sidereal time period seems to be a very difficult one. J. J. S.

**3906. Cosmic Ultra-Radiation. V. F. Hess.** *E.T.Z.* 52. *pp.* 936–937, *July* 16, 1931.—Attention is directed particularly to Regener's recent work [see Abstract 1295 (1931)] on cosmic radiation. This is discussed in its relation to other work on this subject, and the paper concludes with a brief review (*a*) of information on the ionisation of the higher layers of the atmosphere, and (*b*) of the latest views of the nature and origin of the cosmic ultra-radiation. A. W.

## CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

**3907. Electron Theory of Metals. L. Nordheim.** *Ann. d. Physik*, 9. 5. *pp*. 607–640, *May* 20, *and* 9. 6. *pp*. 641–678, *May* 28, 1931.—Since it has been shown by Pauli and Sommerfeld that by the development of Fermi's statistic the difficulties of the old electron theory are largely obviated, the problem of the calculation of the free path of the electrons has been attacked by various authors. Whilst the mechanism of the process of conduction can be considered as now to a considerable extent made clear, objections may be raised against the method of treatment in various cases. Consideration of the numerous consequences of the theory has been made more difficult in some cases. Houston, who gives the most comprehensive numerical results, has borrowed in a questionable way from the optics of X-rays in order to calculate electron scattering. Besides, he does not use the correct fundamental equation for the Fermi statistic, which especially for low temperatures is not permissible. These points are fully explained by Bloch and Peierls. The author of the present paper has thought it well to consider this whole subject from a unitary point of view, and though at first sight it appears complicated, yet by simplification of the calculations satisfactory clearness may be attained. The following are the contents of the chapters into which the paper is divided: (1) By summary of known results on the mechanism of electrons in periodic fields the physical standpoint is established. (2) The statistic fundamental equation is treated. This in connection with Bohr's reflections is brought into the clearest possible and most general form, and is drawn out into its consequences. (3) The transition probabilities are considered. (4) The conductivities are actually calculated, and in an Appendix a secondary effect is examined, and in another Appendix some much used formulæ are deduced. The chief results attained are as follows: (*a*) For good conductors free electrons exhibit also a physically satisfactory approximation to the actual relationships. (*b*) The thermodynamic relations for thermoelectricity are observed as quite general consequences of the kinetic theory. (*c*) For high temperatures Sommerfeld's results are thoroughly justified. In its sense a free length of path for the electrons may be brought in. In consequence Wiedemann and Franz's law also holds for good conductors, with its value of the constants. (*d*) The dependence on temperature of the electric resistance is satisfactorily restored. (*e*) The absolute value of the electric resistance is obtained, so far as order of quantity is concerned, without actual hypotheses *ad hoc*. (*f*) The behaviour of alloys finds its full explanation. The Matthiesen rule of the additivity of the extra and ordinary resistance is a fair first approximation. The additional resistance for solid solutions, not explainable by the classical electron theory, is seen to be an interference effect of the electron waves. Its dependence on the proportion of mixture and its absolute value are in good agreement with experiment. The behaviour of crystallite mixtures and metallic compounds is qualitatively foreseen. J. J. S.

**3908. Electrical Conductivity of Metals. C. D. Niven.** *Canad. J. of Research*, 5. *pp*. 79–86, *July*, 1931.—It is pointed out that mathematicians in their attempts to form theories of electrical conduction do not lay emphasis on the fact that at low temperatures resistance, as a rule, does not vanish. In those cases in which it does, it vanishes suddenly. In view of this, the question arises as to whether the right model for conductivity in a metal is visualised. It is suggested that fundamentally a metallic atom is one in which the electron configuration is incomplete. Ordinary conduction consists of a process whereby an electron jumps from one atom to another and remains with the atom it jumps to until it is in a sort of equilibrium with the motions of the electrons already on that atom. In the super-conducting state, the electronic orbits of different atoms become synchronised so that when an electron leaves one atom, another electron automatically comes on to the atom to take its place. A study of the resistance-temperature curves as well as other points emphasises the importance of structure in conductivity. AUTHOR.

**3909. Electrical Conductivity of Thin Metal Sheets. G. Braunsfurth.** *Ann. d. Physik*, 9. 4. *pp.* 385–418, *May* 7, 1931.—In the study of the electrical conductivity of thin layers of metal certain anomalies have for long been observed. These are obstacles to physical research which have not yet been removed. This arises from the fact that investigations have not always been carried out under conditions so definite that the observations of different investigators can be compared; and moreover not all anomalies have been described as such. The present paper deals with the subject at considerable length both theoretically and practically, and the chief points may be thus summarised: (1) A method is given for determining the thickness of very thin metal sheets depending on a special function connecting the resistance and the thickness. In a thickness of layer of approximately $1 \times 10^{-8}$ cm. the observed resistance-thickness function can be rendered by the following equation: $W = K(1/(D - x) + a/(D(D - x)))$, where W = resistance, D = thickness of sheet, and K, $a$ and $x$ are constants. By means of the new resistance-thickness function and Matthiesen's rule the dependence of the temperature coefficient on the thickness is calculated in a special case, that of Pt. (2) In the case of the noble metals Pt, Ir, Rh the absolute thickness of the anomalous surface layer lies between $2 \times 10^{-8}$ and $1 \times 10^{-7}$ cm. (3) With the lessening of the thickness of the layer, hysteresis, which can be lessened by the specific activity of certain gases, appears in the temperature-resistance curve. (4) In thinning sheets certain peculiar oscillation phenomena increasingly occur. These "kink points" are only observed with changed conditions in the surrounding gas atmosphere, and are probably caused by loosening of the structure, which, on its side, is conditioned by volume changes in the sheet. (5) Metal crumbled into dust is in a special phase in which it does not conduct electricity, and is transparent. Such metal can be "aged." The ageing consists in a diminishing of the resistance of the layer, and can be artificially produced by heating to a minimal temperature, which is different for different metals. By ageing the dependence on temperature is raised. (6) As arises from the greater lessening of the temperature-dependence in alloys, even with relatively thin layers, formation of mixed crystals occurs. (7) The temperature coefficient decreases with increasing specific resistance. It also decreases with increasing hysteresis. (8) The influence of the surrounding gas can be expressed by $\log t = (\log W)^n$, where $n = 2$ or $3$, $t$ = time, W = resistance. (9) In the measurement of the temperature coefficient fundamental difficulties occur on account of the fact that resistance is not only a function of the temperature, but at the same time depends on about six other parameters which are interconnected in an unknown way. J. J. S.

**3910. Electrical Properties of Gold Alloys. J. O. Linde.** *Ann. d. Physik*, 10. 1. *pp.* 52–70, *June* 24, 1931.—The atomic increase in resistance on addition of Cu, Ni, Co, Fe, Mn, Cr, Ag, Pd, Pt, Rh, In and Sn to Au has been measured at temperatures between 20° and – 190° C. The rule of Norbury, that the atomic increase in resistance is the greater the further is the solute metal from the solvent metal in the periodic table, is found to fail when the solute metals are transition elements. According to Matthiesen's law the temperature coefficient of resistance of a dilute metallic solid solution should be very little different from that of the solvent metal. This law is not always true, and finds its main exceptions amongst the transition elements. Further, the temperature coefficient of the resistance of a solid solution changes with change of concentration of solute in such a way that they are proportional to one another. F. J. W.

**3911. Influence of Electromagnetic Radiation on the Resistance and Hardness of Metals and Alloys. G. Mahoux.** *Comptes Rendus*, 193. *pp.* 27–29, *July* 6, 1931.—When exposed to radiation of wave-length 44 m. various iron and aluminium alloys experience a diminution of electrical resistance, which varies with time. After about 2 hours the resistance falls abruptly, and then increases slowly without, however, attaining the initial value; this cycle is repeated, although more feebly, every 2 hours. The initially polished surface of the metal becomes covered with alternating light and dark bands, indicative of the production of stresses within the metal; this view is confirmed by a general increase of (Brinell) hardness and by local variations of hardness corresponding with the bands.

H. F. G.

**3912. Conductivity of Pure Liquids. A. Nikuradse.** *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 59–64, *June*, 1931.—The so-called pure hexane of commerce exhibits a somewhat large specific conductivity of $10^{-12}$ to $10^{-13}$ ampere/volt × cm./cm.$^2$. This conductivity is especially caused by moisture, suspensions and electrolytic mixtures, which have their seat partly in the liquid, partly at the walls of the containing vessel and at the electrodes. The object of the research undertaken was to carry to the utmost the purification of the substance examined. Thus a physically definitely defined liquid was obtained. Hexane was used in the investigation. This substance was used for testing the current conduction phenomenon in dielectric liquids at high temperatures and for the study of the processes going on in the boundary layer between metal and pure dielectric liquid (contact potential). From the employment of the purification methods worked out for dielectric liquids the lower limit of the value of the specific conductivity of hexane was found to be $10^{-19}$ ampere/volt × cm./cm.$^2$. J. J. S.

**3913. Thermoelectric Power of Nickel at the Curie Point. K. E. Grew.** *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 217–220, *May*, 1931.—The thermoelectric power of nickel was measured with reference to platinum, and the change in the specific heat of electricity was found to be $4 \cdot 9 \times 10^{-24}$ cal. per electron per degree, a value in good agreement with those found previously [see Abstract 2830 (1929)]. Some irregularities were noted above the Curie point. [See also Abstract 2047 (1931).]

G. E. A.

**3914. Thermo-E.M.F.s with Palladium, Iron and Palladium-Silver Alloys Charged with Hydrogen. R. Nübel.** *Ann. d. Physik*, 9. 7. *pp.* 826–838, *June* 10, 1931.—The relations between thermo-e.m.f. and the Peltier and Thomson effects are valuable reciprocal connections, but teach little more than what is known from the dependence of thermo-e.m.f. on temperature; and the known fact that bad conductors give in general high thermo-e.m.f.s shows little more than that thermo-e.m.f. depends on the constants of two bodies. The author has examined the behaviour of Pd and of Pd-Ag alloys in order to find whether the parallelism between thermo-e.m.f. and the H absorbed which occurs with Pd holds also for the Pd-Ag alloys, and also whether a relation exists between thermo-e.m.f. and photoelectric sensitiveness. The following are the results obtained: (1) The connection which has been found between the mass of H taken in by Pd and the nature and concentration of the electrolyte holds also in the case of the thermo-e.m.f. of the charged Pd in this electrolyte. (2) A marked change with time of the thermo-e.m.f. of iron charged with H takes place, and indeed a decrease up to vanishing point of the effect. (3) As in the case of Pd the thermo-e.m.f. with Pd-Ag alloys increases with decrease of the concentration of the electrolyte first of all, attains a maximum at about 1 $N$ of $H_2SO_4$, and thereafter decreases. (4) The thermo-e.m.f. increases with the duration of the electrolysis. (5) There appears a strongly marked maximum of the thermo-e.m.f. at 40 % silver content of the Pd-Ag alloy. (6) The direction of the thermo-current of the Pd-Ag alloys is as with H-charged Pd. J. J. S.

**3915. Thermoelectric Forces Produced by a Magnetic Field. S. R. Williams.** *Science*, 74. *pp.* 75–77, *July* 17, 1931.—If by any means the two arms of an angle, or the adjoining lengths, of a continuous material can be given different structures so that when placed in the path of some physical agent they will behave differently, then a thermal e.m.f. will be set up between the two constituent portions. Thus a stretched and unstretched portion of a wire, or again a permanently magnetised and an unmagnetised section of the same piece of ferromagnetic wire will exhibit this phenomenon. If a continuous iron or nickel wire is bent into a U-shape and placed between the poles of an electromagnet, one bend of the wire being maintained at the temperature of steam while the other is in a freezing mixture, on excitation of the electromagnet an e.m.f. occurs which is measurable. Thus these two sections of the wire, the transversely and longitudinally magnetised portions respectively, develop different structures, and may, therefore, serve as a thermocouple. The paper discusses the theoretical and practical consequences of this phenomenon.

S. G. B.

**3916. Frequency Dependence of Sparking Potential in Air. H. Lassen.** *Arch. f. Elektrot.* 25. *pp.* 322–332, *May* 9, 1931.—The sparking potential in air at atmospheric pressure is measured for various frequencies between 100,000 to 3,000,000 ∼ and for sparking potentials between 0 and 15,000 volts and compared with corresponding l.f. measurements. It is found that for constant spark length lower and upper regions exist, in which the sparking potential remains constant; between these a region exists in which the sparking potential decreases with increasing frequency. The position of this region of decreasing sparking potential is dependent on the length of spark. The dependence of sparking potential on spark length for constant frequency is also investigated. An explanation of

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the observed effects is proposed which is based on the formation of space charges in the discharge. H. L. B.

**3917. Theory of Electrodeless Discharge. F. Esclangon.** *Comptes Rendus,* 192. *pp.* 1211–1212, *May* 18, 1931.—Referring to J. J. Thomson's theory [see Abstract 702 (1928)] of the electrodeless discharge in a rarefied gas, placed in the interior of a solenoid traversed by h.f. current in which the essential rôle is played by the electric field induced by the alternating magnetic field of the solenoid, the author describes experiments he has made to confirm Thomson's theory. J. S. Townsend and R. M. Donaldson have suggested that the resultant electric field is almost identical with the alternating electrostatic field which owes its origin to the electric charges existing on the turns of the coil. The author has reproduced the electrostatic field of the solenoid in the absence of the magnetic field, and has been able to suppress the electrostatic field while allowing the magnetic field to subsist. The induced field can provoke a discharge more brilliant than that due to the electrostatic field, although it is less intense than the latter. When once the discharge is produced the gas is ionised and behaves like a conductor. In general the transversal currents due to the induced electric field are the notable ones and not the longitudinal currents. J. J. S.

**3918. Discharge Figures and Photographic Plates in Fluids. K. Przibram.** *Phys. Zeits.* 32, *pp.* 481–482, *June* 15, 1931.—Discharge figures are given for two liquids, isoamyl alcohol and butyric isobutyl. The potential surges were obtained by means of the usual Toepler arrangement, a wire being sealed through the end of a glass tube and the projecting end of the wire held near the photographic plate which was immersed in the liquid in a flat porcelain dish. In the case of amyl alcohol the negative figure is more extensive than the positive, while in the other liquid the reverse is the case, as in air. The results are briefly discussed and compared with those of Toriyama [see Abstract 620B (1931)] and others. A. W.

**3919. Measurement of Kathode Fall of Potential. C. Jung.** *Helv. Phys. Acta,* 4. 3–4. *pp.* 189–212, 1931. *In German.*—A discussion is given of the relative merits of different methods of measuring the kathode fall of potential in a discharge tube and experimental investigations are described which show that, when all possible precautions are taken as to purity of electrodes and of the probes used, the minimum potential for a large number of electrode materials is only a little higher than the value of the kathode fall measured by means of probes at the boundary of the glow. Neglecting this small difference, both values exhibit large differences among themselves; they are not constant with time and are very seldom reproducible. Al and Mg are least of all suitable as electrode materials if it is desired to deduce the kathode fall of potential from measurements of the minimum potential. In view of the results obtained the author disagrees with Güntherschulze as regards the relative merits of the probe and the minimum potential methods and is more in agreement with Wehnelt, who expresses the view that the probe method is not so liable to error as many have assumed. A. W.

**3920. Effect of Degassing the Anode in the Anomalous Glow Discharge. F. M. Penning.** *Zeits. f. Physik,* 70. 11–12. *pp.* 782–785, *July* 29, 1931.—Güntherschulze has found that in hydrogen, when two plane electrodes of nearly the same diameter as the cylindrical glass tube are gradually brought nearer together, with constant current, there is a drop of the voltage to a minimum when the electrodes come close together, and a rise in voltage when they are brought still nearer to one another. The author has found that this drop of voltage to a minimum continues to take place after the anode has been degassed by heating it to 400° C., and in the same manner when it has been made bright red hot several times by means of h.f. currents. H. N. A.

**3921. Pseudo High Vacuum. E. Badareu.** *Zeits. f. techn. Physik,* 12. 6. *pp.* 298–303, 1931.—The values of the excitation potential obtained simultaneously in different discharge chambers in which the distance of the electrodes from the walls was not the same, all other conditions being identical, showed large differences, which were the greater the lower the gas pressure (pseudo high vacuum). This effect is shown to be due principally to charges on the walls of the discharge chamber. Such charges occur partly as a result of normal discharge and partly as a result of short duration discharge impacts which are never observed with ordinary research arrangements. These charges on the walls of discharge chambers can give rise to considerable errors in the measurement of the characteristics of a gas discharge at low pressures. [See also Abstract 1706 (1925).] A. W.

**3922. Measurement of Lenard Rays. L. S. Taylor.** *Bureau of Standards, J. of Research,* 7. *pp.* 57–72, *July,* 1931.—An investigation is described in which the correct measurement of the electron output (Lenard current) from h.t. kathode ray, or Lenard ray tubes, is attempted. The evidence presented shows that a Faraday chamber of proper dimensions may be used to measure the Lenard ray current which at any point is shown to be a linear function of the total tube current. The open-plate method of measuring Lenard currents yields results which are consistently too low, although under the conditions here used bear a constant relationship to the Faraday chamber measurements. The open-plate measurements are, therefore, also a linear function of the total tube current. The condenser method of measurement (Thaller) yields measurements above or below those of the Faraday chamber, depending upon the relationship of the atomic numbers of the two plates. Moreover, the current measured by this method is not a linear function of the total tube current, and hence does not bear a constant relationship to the Faraday chamber measurements under the conditions used. Measurements of the range of scattered electrons from Lenard tubes operating at about 160 kV peak, indicate a maximum of about 15 mm. in air, which is equivalent to an energy of about 60 electron kV. By means of a variable Faraday chamber described, it is possible to obtain a measure of the velocity distribution of the scattered electrons. AUTHOR.

**3923. Recombination of Ions in the Normal Arc. E. H. Bramhall.** *Cambridge Phil. Soc., Proc.* 27. *pp.* 421–429, *July* 31, 1931.—A copper arc was employed with a probe consisting of a platinum wire which could swing horizontally at a known velocity through the arc half-way between the vertical electrodes. The generator voltage and circuit resistance were so adjusted that the slight disturbance caused by the passage of the probe extinguished the arc. The probe potential was negative, and the current through it was due to the positive ions it collected. The current was measured by means of an oscillograph, so that the post-arc ion density could be found directly as a function of time. The experimental results agree with the theory, and the coefficient of recombination was found to be $a = 5\cdot7 \times 10^{-9}$. If the temperature of the gas in the path of the arc immediately after extinction is 2500° C., a comparison of this value and that accepted for normal conditions shows that $a$ varies approximately as the $2\cdot5$ power of the temperature, which is in agreement with the existing data. H. N. A.

**3924. Changes in Gaseous Ions with Time. J. Zeleny.** *Am. Phil. Soc., Proc.* 70. 2. *pp.* 121–135, 1931.—By means of apparatus similar to that used previously [see Abstract 306 (1930)], diagrams show that, in dry air, the mobilities of both positive and negative ions decrease regularly with age, the decrease for positive being about 15 % in 0·5 sec., that for negative being considerably less. In moist air the values of the mobilities on different days show large divergence among themselves for new ions, although results are invariable when much older ions are used. The objection may be made that, as air is continuously drawn through the apparatus, a high degree of purification cannot be obtained, but high values of mobilities for both positive and negative ions indicate that this is unlikely. H. M. B.

**3925. Energy Loss and Scattering of Fairly Rapid Electrons During Passage Through Gases. Part II. Neon and Argon. M. Renninger.** *Ann. d. Physik,* 10. 1. *pp.* 111–128, *June* 24, 1931.—Continues an earlier paper [see Abstract 3201 (1931)] in which the loss of energy of electrons of initial velocities corresponding to 500–2000 volts was determined after passing through nitrogen. The same method and apparatus is now applied to electrons traversing neon and argon. The results are similar in essential points to those for nitrogen. For 500-volt electrons the curves of distribution of energy losses show a maximum near the excitation potential, the latter being higher for argon than for nitrogen or neon. On the side of high energy losses the curves fall gradually away to zero. With 2000-volt electrons a second maximum appears in the descending part. This moves towards the high energy loss side with increasing angle of deviation. The excitation step which appears in the distribution curves for nitrogen, appears also for argon, but not for neon. The ionisation of the L-shell is shown by the energy losses in the case of argon, especially with the 2000-volt electrons. The quantity of electrons elastically and inelastically scattered at various angles can be qualitatively determined. The curves show, as expected, a more rapid falling away of the inelastic part with increasing angle of deviation. Conclusions concerning the apportionment of energy losses to the two kinds of collision are drawn. N. D.

**3926. Energy Losses of Slow Electrons in Hydrogen. H. Ramien.** *Zeits. f. Physik,* 70. 5–6. *pp.* 353–374, *July* 6, 1931.—A swarm of electrons, initially possessing approximately equal kinetic energies, traverses a vessel containing hydrogen, and the resulting distribution of velocities is measured. Readings are taken with initial energies lying within the range 3·5 to 12 volts, and with various definite values of the gas pressure. A comparison of the behaviour of such electrons with that of others traversing helium under similar conditions gives some important results. Below about 9 volts, an electron in hydrogen loses on an average a quantity of energy proportional to the number of its collisions with gas molecules. This is interpreted to mean that a "fundamental" quantum of energy is sometimes given to a hydrogen molecule during a collision. The energy transferred is calculated, and its dependence on the velocity of the electron is explained. A loss of energy of 4·2 volts, which would correspond to dissociation, has not been detected. A method has been developed by which the average loss of energy of electrons whose initial energy exceeds 9 volts can be calculated. A particular electron jump inside the molecule, corresponding to the loss, is suggested. The absolute gain of energy during excitation is obtained as a function of the velocity of the electrons. It is shown that the transition $1^1S$ to $1^3S$ is produced. N. D.

**3927. Transference of Charge and Ionisation During the Passage of Protons Through Gases. F. Goldmann.** *Ann. d. Physik*, 10. 4. *pp.* 460–484, *July* 21, 1931.—When a proton, $H^+$, collides with a molecule B, it may transfer its positive charge to the molecule: $H^+ + B = H + B^+$. On the other hand the proton may ionise the molecule: $H^+ + B = H^+ + B^+ + e^-$, where $e^-$ represents an electron; if the electron then unites with the proton a neutral hydrogen atom is formed, a transference of charge (*Umladung*) from the proton to the molecule having taken place. Measurements have been made with protons accelerated by 500 to 4000 volts in hydrogen, 1500 to 4000 volts in argon and 1000 to 4000 volts in helium. Transference of charge took place in $H_2$ and A, but no marked ionisation; in helium neither charge transference nor ionisation could be observed. The charge-transference sectional area of hydrogen for protons increases with increasing velocity, at first slowly and then more rapidly. At about 1000 volts it is greater than the gas kinetic sectional area. The value in argon is far above the gas kinetic value. No deviations of the protons through large angles were observed between 400 and 4000 volts either in $H_2$ or A. In agreement with this, charge-transference sectional area and effective sectional area are practically the same. At high pressure there was evidence of excitation or ionisation by high velocity neutral atoms. H. N. A.

**3928. Diffraction of Proton Waves. Y. Sugiura.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 310. *pp.* 29–40, *July*, 1931. *In English.*—A strong stream of protons was obtained from a palladium anode tube, into which hydrogen was passed, heated by bombardment with electrons coming from a ring-formed, hot, negative filament. Thin metal films of platinum or tungsten, deposited on glass plates by kathode sputtering, were used for the diffractor. The protons were accelerated by a grid and passed through a narrow canal into a magnetic field which deflected them through 60°, so that they passed through two narrow slits and fell on the diffractor. The diffracted protons were measured with a sensitive Compton electrometer. For an accelerating voltage $V = 300$ volts, the de Broglie wave-length for a proton is $\lambda = 0{\cdot}0162$ Å. Using the Bragg equation, as employed for X-rays, the diffractions obtained experimentally correspond to this wave-length, and the same agreement holds for other accelerating voltages.
H. N. A.

**3929. Crystal Interferences of an Electron with Spin. H. Hellmann.** *Zeits. f. Physik*, 70. 9–10. *pp.* 695–698, *July* 22, 1931.—The author in his previous paper [see Abstract 3206 (1931)] attempted to explain Rupp's results, but found that the sign was reversed. As this is now shown to be due to an error by Rupp, the author has continued the mathematical investigation, and obtains an equation which corresponds to the optical vibration equation. The theory seems capable of explaining some further experimental results of Rupp. Unfortunately the method of approximation employed in geometrical optics breaks down in the case where there is marked spin, so that quantitative results cannot be obtained. The general view of the author is that with large angles of dispersion the passage through a large field is indicated. Only one atom contributes to the polarisation, and the field is only active in the short time during which the electron passes through the nuclear region of this atom. On the other hand, with grazing incidence the electron passes only through rather weak fields due to a number of atoms, the fields being all more or less in the same direction. H. N. A.

**3930. Theory of the "Schrot" Effect. H. J. de Boer.** *Phys. Zeits.* 32. *pp.* 482–483, *June* 15, 1931.—Fürth has given a simple theory of the "Schrot" (small shot) effect [see Abstract 541 (1923)]. The present paper extends Fürth's theory slightly and leads to a formula in agreement with one obtained by Ornstein and Burger in quite a different way. [See Abstract 1432 (1923).] A. W.

**3931. Influence of Chemical and Physico-Chemical Processes at the Surfaces of Metals with High Melting Points on Their Thermionic Properties. K. Becker.** *Phys. Zeits.* 32. *pp.* 489–507, *July* 1, 1931.—This is a report describing the influence of low pressure atmospheres of hydrogen, nitrogen, oxygen, argon, vapours of water, phosphorus, iodine, mercury, the alkali and alkaline earth metals on the electron emission from hot platinum, tantalum, tungsten, palladium and other metals. Three types of effect are discussed. Special consideration is given to cases of adsorption of two kinds of atoms by a metal surface. N. D.

**3932. Emission of Electrons Under the Influence of Chemical Action. A. K. Denisoff and O. W. Richardson.** *Roy. Soc., Proc.* 132. *pp.* 22–50, *July* 2, 1931.—The electron emission from $NaK_2$ when acted on by $COCl_2$ [see Richardson and Grimmett, Abstract 2030 (1931)] has been re-examined by improved methods over the pressure range $2 \times 10^{-7}$ to $\sim 10^{-3}$ mm. At the very lowest pressures the total emission is proportional to the pressure, but the rate of increase falls off somewhat as pressures of about $10^{-5}$ mm. are attained. At about $3 \times 10^{-5}$ mm. the emission shows a sharp maximum, followed by a decrease which steadily diminishes until there is little further variation at pressures comparable with $10^{-3}$ mm. The effective temperature of the emitted electrons has been determined under satisfactory conditions and is found to be 2370° K. over the whole range from $2 \times 10^{-7}$ to $10^{-2}$ mm., with an uncertainty of about 5 % at the lowest pressures. T. H. P.

**3933. Photoelectric Effect in Thermionic Valves. Q. Majorana.** *Accad. Lincei, Atti,* 13. *pp.* 318–323, *March* 1, 1931.—A further investigation has been made of the photoelectric effect already described [see Abstracts 1651 and 1652 (1929)] in which a pulsating beam of light falls on a triode. A summary is given of the observations made, the explanation of which is in many respects not yet clear. J. J. S.

**3934. New Photoelectric Phenomenon. Q. Majorana.** *Accad. Lincei, Atti,* 13. *pp.* 463–469, *April* 12, 1931.—Further investigates the

phenomenon of the negative charge of a photoelectric kathode when illuminated by red light. The charge is not due to gas, as gas-filled cells show the same behaviour as vacuum cells. The author has examined a number of commercial cells of various makes, using an electrometer as well as a sensitive galvanometer. He used various coloured glass screens, and found that the less refrangible rays tend to produce a positive charge. He has not yet formed an hypothesis to account for the phenomenon.
E. E. F. d'A.

**3935. New Photoelectric Effect. Q. Majorana.** *Accad. Lincei, Atti*, 13. *pp.* 641–642, *May* 3, 1931.—Refers to the reciprocal action of long-wave and short-wave radiation in lowering the discharge potential in photoelectric tubes containing alkali metals. Maintains that the phenomenon deserves further investigation, and that the theory of Marx and Meyer [see Abstract 2429 (1931)] should be studied in gas-filled cells as well as vacuum cells. E. E. F. d'A.

**3936. Photoelectrons Excited by H.F. X-Rays. E. Lutze.** *Ann. d. Physik*, 9. 7. *pp.* 853–864, *June* 10, 1931.—Studies the asymmetry in the direction of the photoelectrons excited by h.f. X-rays by means of a modified Wilson fog chamber. With X-rays of wave-length 0·135 Å. he finds that half the electrons have a direction within 58° of the primary beam. This is in good agreement with the calculations of Sommerfeld, Wentzel and Fischer. E. E. F. d'A.

**3937. Accuracy of Gas-Filled Photoelectric Cells. W. R. G. Atkins.** *Roy. Dublin Soc., Proc.* 20. *pp.* 67–73, *May*, 1931.—A gas-filled cæsium hydride cell was tested for constancy of emission after the glow-discharge had been passed momentarily; a variation of about 33 % was found at 143 volts anode potential. Immediately after the glow-discharge the sensitivity decreased at a rate of about 2 % per minute. It was, however, found to rise subsequently. A gas-filled potassium hydride cell was similarly tested for constancy of emission, and the variation was found to be within 2 % with a current of about 5μA, the anode potential being 59 volts; at 166 volts the constancy appeared to be somewhat less. The rate of decrease of sensitivity after the glow amounts to about 2 % at 166 volts, and over 3 % at 59 volts. It is therefore advisable to make measurements immediately after the discharge, which should be of momentary duration only. H. L. B.

**3938. Fatigue in Photoelectric Cells. G. Kortüm.** *Phys. Zeits.* 32. *pp.* 417–425, *June* 1, 1931.—The relation between photoelectric current $i$ and light intensity J, expressed by Steinke in the form $i^2 = c\mathrm{J} + \text{const.}$ is sufficiently approximate for all the cells examined, but the cell constant only rarely is unity and independent of current and wave-length. The sign of $z$ may change in the same cell with the experimental conditions. Its value is not reproducible at will, so that a single-cell apparatus cannot be used for absolute measurements. E. E. F. d'A.

**3939. Formation of Photoelectrons in Chemical Photoelectric Cells. S. E. Sheppard and W. Vanselow.** *Phys. Zeits.* 32. *pp.* 454–455, *June* 1, 1931.—The authors defend the ionic conception of the photoelectric process in silver with silver salts against Schottky's criticism [see Abstract 1380 (1931)], who bases his view on the absence of fatigue in cuprous oxide cells. The authors maintain that in photoelectric cells of the type Ag-AgBr-KBr-AgBr-Ag, the illuminated electrode is momentarily negative towards the electrode in darkness, but that this is immediately followed by a reverse current due to the transfer of bromine ions, which attack the silver electrode. E. E. F. d'A.

**3940. Limiting Potentials in Alkali Photoelectric Cells. A. E. H. Meyer.** *Ann. d. Physik,* 9. 7. *pp.* 787–825, *June* 10, 1931.—Investigates the photoelectric regression effect observed by Marx, and finds that the limiting potential is lowered owing to the addition of a long-wave component. E. E. F. d'A.

**3941. Dispersion of Hertzian Waves in Solid Bodies. J. Errera.** *Phys. Zeits.* 32. *pp.* 369–373, *May* 1, 1931.—Following upon previous observations by the author [see Abstract 1139 (1928)] upon this subject, he now gives an account of the examination of Seignett salt ($NaKC_4H_4O_6$, $4H_2O$), which on account of its special piezo and dielectric peculiarities is of great interest. For the investigation of the relation between frequency and dielectric constant, which had not been previously observed, the author used a Nernst bridge. For the wave-length from 100 m., measurements by the suspension method were made and the results were the same as with h.f. measurements in the bridge. The results of the dispersion measurements are given in tables and in a diagram in which the logarithm of the wave-length is abscissa and the dielectric constant is ordinate. Existence of dispersion is shown. The low and the high values of the dielectric constant at the same field strength are distinct through the resonance region (strong absorption, negative dielectric constant value). Further, there is shown in the region of great wave-length dependence of the values of dielectric constant on strength of field, and indeed this increases with increasing field strength. Various further experiments on the behaviour of Seignett salt in different conditions (compressed, pulverised) are described, and observations with a.c. were made. Further experiments on the dependence of dielectric constant on field-strength and also the study of other water-containing crystals are to be carried out. J. J. S.

**3942. Oscillation Form and Temperature Coefficient of Quartz Oscillators. H. Straubel.** *Zeits. f. Hochfrequenztechn.* 38. *pp.* 14–27, *July,* 1931.—With quartz oscillators of the ordinary disc type certain natural directions of oscillation are found. These make with the optic axis angles of − 48° 19′ and + 71° 32′ and correspond with directions of maximum and minimum values of Young's modulus. In the case of oscillators in the form of rods it is recommended that these directions should be chosen for cutting, instead of the direction at right angles to the optic axis which has hitherto been principally employed, since only for such directions do the calculated and observed frequencies agree. In addition, the direction of the oscillations is accurately along the axis of the rod, as is shown by the glow *in vacuo* being at right angles to the rod length. With disc-shaped oscillators complex types of oscillation occur, but these can be simplified to a certain extent by suitable shaping of the periphery. Such an oscillator has a higher specific power than ordinary rod oscillators. The frequency constancy of quartz-controlled transmitters depends on the operating conditions. An experimental investigation is described of the conditions giving the greatest possible constancy. Some types of crystal-holders are very sensitive to shock; arrangements are described for reducing such effects. The temperature coefficient of quartz oscillators is determined partly by the thermal expansion and partly by the temperature variation of the elastic modulus, so that by suitable choice of the linear dimensions a definite value for the temperature coefficient for given temperatures may be assigned, and in certain cases the coëfficient may be made zero. A comparison between the static and dynamic temperature coefficients of the modulus of elasticity is found to be impossible on account of complications introduced by resonance effects between the longitudinal and transverse oscillations. A. W.

**3943. Rotation of Permalloy and Soft Iron by Magnetisation and the Nature of the Elementary Magnet. S. J. Barnett.** *Am. Acad., Proc.* 66. 8. *pp.* 274–348, *June*, 1931.—The paper opens with a concise survey of present knowledge, defining the $m/e$ ratio as being the ratio of electron mass to electron charge. The most important quantities associated with the elementary magnet are its magnetic moment $M_0$, its angular momentum $\mu_0$ and its gyromagnetic or magneto-magnetic ratio, $\rho = M_0/\mu_0$. The value of $\rho$ has been determined with considerable accuracy, but no method has been devised for the determination of $M_0$ and $\mu_0$ separately. The work separates itself into two opposite methods, *viz.* magnetisation by rotation and rotation by magnetisation. The present work records full experimental details of an elaborate investigation on the latter, *i.e.*, the rotation of certain substances by magnetisation. The various disturbing factors are discussed *seriatim*. The work deals mainly with the determination of the ratio $\rho/\rho_L$ where $\rho_L$ is the gyromagnetic ratio of an elementary magnet consisting of a Lorentz electron spinning on a diameter, *i.e.*, $\rho_L = m/e$ or $\frac{1}{2}\rho_B$, where $\rho_B$ is the value for an electron moving about a nucleus or atomic core in an orbit, *i.e.*, a Weber-Rutherford-Bohr magneton. The final table comparing the values of the ratio $\rho/\rho_L$ for iron and for permalloy show that the average value for iron is given as $1 \cdot 037 + 0 \cdot 003$, and for permalloy as $1 \cdot 049 \pm 0 \cdot 003$. There is little difference between the results as obtained by the different methods. The new results are entirely consistent with those previously published by the author and L. J. H. Barnett, which give as the mean value of $\rho/\rho_L$ from experiments on magnetisation by rotation the number $1 \cdot 05_9$. The work on magnetisation by rotation was not precise enough to reveal differences between gyromagnetic ratios for different substances. The present results show, however, that by consideration of rotation by magnetisation there is a distinct difference between permalloy and iron, the gyromagnetic ratio for the former being about 1 % greater than the latter. This difference is outside the limits of experimental error and is considered to be real. The exact interpretation is not yet determined, but it is suggested that, inasmuch as the gyromagnetic ratio equal to almost exactly $m/e$ is required to explain the Zeeman effect and other spectroscopic phenomena, it seems probable that the chief magnetic element in ferromagnetic substances is the spinning electron with $\rho = m/e$, but that there is also some contribution due to orbital electron motion. This being so, experimental values for $\rho$ should be somewhere between $m/e$ and $2m/e$, and the small difference between permalloy and iron is not surprising. S. G. B.

**3944. Comparison of Small Magnetic Susceptibilities. R. A. Fereday.** *Phys. Soc., Proc.* 43. *pp.* 383–393, *July*, 1931 —In continuation of an earlier investigation [see Abstract 3244 (1930)], it is shown that a magnetic field, specially suitable for determinations of relative susceptibility by an improved non-uniform field method, can be produced by an electromagnet whose pole-pieces are respectively plane and spherically concave. AUTHOR.

**3945. Cross-Sectional Effect in Magnetostriction. A. Esau.** *Phys. Zeits.* 32. *pp.* 483–485, *June* 15, 1931.—A further discussion on the effects of magnetostriction. The length and the volume effects have been measured, and now the author suggests a method for the deduction of the cross-sectional effect from these values. He takes the values due to Nagaoka for the volume and length effects for iron, nickel, nickel-steel, cobalt, etc., and calculates the cross-sectional effect for these substances. This effect is very small for field values below 100 gauss. In correspondence with the Villari point, which lies about 125 gauss in the case under consideration, it becomes positive and reaches a considerable value at field strengths of 700 gauss for cobalt. Other substances are similarly recorded. S. G. B.

**3946. Anisotropy of Magnetisation of Ferromagnetic Single Crystals. F. Bloch and G. Gentile.** *Zeits. f. Physik,* 70. 5–6. *pp.* 395–408, *July* 6, 1931.—The magnetic mutual effects of the elementary magnets in ferromagnetic single crystals is investigated theoretically in the present paper. It is shown that for hexagonal crystals the mutual magnetic dipolar effect on the spin, and *vice versa,* is to the first approximation given by the empirical dependence of the energy upon the magnetisation, and that the mutual effect of spin and path is given by the same argument to the second approximation. For cubic crystals mutual spin effect is again according to the first approximation, and the spin/path effect in this case is to the fourth. An evaluation shows that the order of magnitude of the effect is correctly given by the above statements. S. G. B.

**3947. Number of Magnetons in Ferromagnetics. A. Wolf.** *Zeits. f. Physik,* 70. 7–8. *pp.* 519–538, *July* 14, 1931.—It is shown mathematically how the number of magnetons in ferromagnetic elements, especially in nickel, can be determined by assuming that a mixture of states (in nickel the triplet and singlet) of varying multiplicity may occur in the lattice. From this has arisen the possibility of calculating the number of magnetons above the Curie point when the magnetic saturation value is known. The results are in good agreement with experiment, and nickel is calculated to have 7·6 magnetons above the Curie point, as compared with 8, Weiss' value. G. E. A.

**3948. Function of the Conduction Electrons in Ferromagnetism. Part III. J. Dorfman, R. Jaanus, K. Grigorow and M. Czernichowski.** *Zeits. f. Physik,* 70. 11–12. *pp.* 796–807, *July* 29, 1931.—Corrects an error in sign in the thermoelectric results recorded in Parts I and II [see Abstract 2830 (1929)]. The conclusions there drawn as to the nature of the elementary magnets in metallic nickel have thus become uncertain. Analogous thermoelectric measurements have now been made with iron. The spring in the Thomson coefficients in iron at the Curie point takes place in the same direction as with nickel, but the absolute magnitude is much smaller. Some possible explanations of the effect are discussed, the final result being that the thermoelectrical method is as yet incapable of giving definite information as to the nature of the elementary magnets. H. N. A.

**3949. Material and Radiational Waves. A. M. Mosharrafa.** *Roy. Soc., Proc.* 131. *pp.* 335–339, *May* 1, 1931.—The Maxwellian equations of electromagnetic and electric theory are derived from one set of basic relations in a manner which throw some light on the relationship between material and radiational waves, and accounts for the existence of exactly three types of physical entities, *viz.*, positive electricity, negative electricity and radiation. It is shown that a physical entity may be associated with the propagation of a vector A in a direction $n$. Besides the two vectors A and $n$, the existence of a scalar quantity $\theta$ is assumed, and $n$ is identified with a unit normal to the wave surface associated with the observable entity (whether material or radiational) and $\theta$ with the normal speed of propagation of the surface so that $\theta n = dn/dt$. If A and $n$ are in the same direction the entity is recognised as positive electricity, if in opposite directions as negative electricity, and if mutually perpendicular as radiation. In the general case A will have a longitudinal and a transverse component corresponding to the existence of matter and radiation. J. J. S.

**3950. Electrodynamic Masses in Quantistic Electrodynamics. E. Fermi.** *N. Cimento*, 8. *pp.* 121–132, *April*, 1931.—The energy of the electrostatic field produced by a point electric charge is infinite, and consequently in the ordinary electrodynamic theory the electromagnetic mass of an electric charge exactly punctiform is infinite. Therefore it is often thought that the electric corpuscles (electrons or protons) cannot be considered rigorously as point charges, but that they have a structure of finite extension. A difficulty quite similar to that of classical electrodynamics is met with also in quantistic electrodynamics, since according to this theory also a point electric charge is necessarily associated with infinite energy, nor is it possible to get rid of this difficulty by altering the value of the energy by an infinite additive constant, since, as Oppenheimer and Waller have shown, the infinite term is not constant, but varies with the variation of the quantic states, and also its variations are infinite. This has its classical counterpart in the fact that considering a point electric charge in motion, not only is the electric energy infinite, but also the magnetic energy that depends on the velocity and corresponds to a first approximation to the electromagnetic kinetic energy. The artifice first presenting itself in seeking to avoid these inconveniences consists in the attempt to introduce also in quantistic electrodynamics something equivalent to a finite ray of the electron. But here a difficulty presents itself greater than that met with in the corresponding classical problems, so that it does not seem possible, at least with the actual scheme of quantistic electrodynamics, to form a theory of an electron with a finite ray whilst maintaining the relativistic invariance. The author considers that in any case there is a certain interest in studying up to what point it is possible to construct a theory of electromagnetic masses since in it some characteristic differences from the classical theory present themselves, and to the study of these the present paper is chiefly devoted. The method adopted is that explained in his previous paper [see Abstract 2052 (1931)] and consists substantially in the consideration as dynamical variables that characterise the electromagnetic field the coefficients of the development in harmonic components of the scalar and vector potentials at a certain instant. J. J. S.

**3951. Determination of the Position of an Electron by Means of a Microscope. K. F. v. Weizsäcker.** *Zeits. f. Physik*, 70. 1–2, *pp.* 114–130, *June* 20, 1931.—A hypothetical experiment is described for the determination of the position of an electron by focussing a microscope on the electron, illuminated with light of sufficiently short wave-length. The analytical discussion of the experiment brings to light difficulties which demand an exact calculation of the problem, which is carried out with the help of the Heisenberg-Pauli quantum-electrodynamics. The results of this investigation are discussed. C. B. A.

**3952. Electron in Homogeneous Electric Field. F. Sauter.** *Zeits. f. Physik*, 69. 11–12. *pp.* 742–764, *June* 13, 1931.—The behaviour of an electron reflected at a potential barrier is discussed by means of Dirac's relativistic wave equation. An electrostatic potential $V = vx$ ($x$ is a rectangular coordinate, $v$ a constant) is taken and the wave equation with this value of V solved in terms of degenerate hypergeometric functions for which approximate expansions, suitable for calculation, are then obtained. It is shown that there is a region where the impulse and the velocity of the electron have opposite signs and the probability of transition from a region of " positive " to one of " negative " impulse is calculated. It is found that this probability assumes a finite value when the potential increase is comparable to the rest-energy of the electron in amount and takes place in an interval equal in length to the Compton wave-length. G. C. McV.

**3953. Reciprocity Theorem in Electricity. J. W. Alexander.** *Tijds. Nederland. Radiogenootschap*, 5. *pp.* 69–84, *July*, 1931.—The reciprocity theorem worked out by Helmholtz and Maxwell, and subsequently adapted to electricity by Rayleigh and Carson, is stated by the author in the form: When an e.m.f. in point 1 causes in the point 2 a current I, the same e.m.f. in point 2 causes the same current in point 1. E. E. F. d'A.

## APPARATUS AND INSTRUMENTS.

**3954. Analysis of Base-Line Values of Autographic Instruments. S. K. Banerji.** *Indian Meteorlog. Dept., Mem.* 25. 7. *pp.* 253–278, 1931.—The determination of the base-line value of an autographic record from absolute observations by taking a mean in an arbitrary manner gives indefinite and indeterminate weights for the self-recording and absolute instruments. The author has analysed the base-line values of the self-recording instruments at Colaba and Alibag Observatories according to their relative reliabilities and the procedure is outlined. Two cases are examined in detail, when the instrumental value is (1) equal to the adopted value on the previous date, and (2) equal to the adopted value on the previous date plus the change as given by the previous two adopted values. It is found that the first assumption furnishes values sufficiently accurate for all practical purposes. The method to be adopted for finding the relative weight and the values of the base line from day to day is explained. R. S. R.

**3955. Ionisation Manometer for Small Pressures. R. Sewig.** *Zeits. f. techn. Physik*, 12. 4. *pp.* 218–221, 1931.—An account is given of the discharge method for high-vacuum measurement with the ionisation manometer. The method found satisfactory was the measurement of the time of discharge of a well-insulating condenser by means of the ionic current, using the Strauss Röntgendosis measurer " Mekapion." With this and an ionisation manometer very small pressures can easily be measured. Some fundamental considerations follow as to the measurement of extremely small pressures with the ionisation manometer. [See also Abstract 2053 (1931.)] J. J. S

**3956. Sputtering of Quartz Fibres. G. M. Jones.** *Journ. Sci. Instruments,* 8. *pp.* 155–159, *May,* 1931.—The paper describes a simple method of sputtering quartz fibres, special attention being paid to the needle suspension of the Compton electrometer. To diminish the risk of cracking the sputtered film when the needle is carried by the fibre, the latter is put under tension during the process of sputtering. Under coil discharge care had to be taken to reduce the vibration of the fibre—excessive vibration caused a break in the sputtered film at the points where the fibre joined its end attachments. When the discharge tube was connected across the d.c. mains (400 volts), a suitable sputtered layer of gold was obtained after an hour's exposure. AUTHOR.

**3957. Capillary Electrometer of Improved Design. A. S. Gilson, Jr.** *Rev. Sci. Instruments,* 2. *pp.* 329–332, *June,* 1931.—A development of the capillary electrometer described by Gilson and Bishop [see Abstract 2986 (1927)]. It can be more easily constructed, more easily handled and duplicated than the earlier instrument. Details of the construction and preparation of the instrument for use will be found in the original paper. H. N. A.

**3958. Instrument for Measuring Small Displacements. B. F. Langer.** *Rev. Sci. Instruments,* 2. *pp.* 336–342, *June,* 1931.—The gauge was developed for use as a stress recorder; but it could be adapted for other purposes. Two U-shaped laminated iron cores are attached rigidly to the base of the instrument and are wound with coils which with two resistances form the arms of a Wheatstone bridge. The legs of the two cores point towards one another, and in the space between them is a laminated iron armature attached to a slide so that it can move to and fro from one magnet towards the other. This alters the impedances of the two coils, and as h.f. current is employed the balance of the bridge is changed. An oscillograph is used to record the resulting current giving a photographic record of the movements of the moving armature. Within the working range the calibration curve may be fairly linear, but for precision work it is necessary to investigate this point. The frequency of the power supply should be at least ten times as great as that of the motion which is investigated. A figure shows records of the stress on both sides of the base of a railway rail, caused by the approach and passage of a locomotive, taken with this instrument. H. N. A.

**3959. New Type of Bridge Balance Indicator. F. T. McNamara.** *Rev. Sci. Instruments,* 2. *pp.* 343–347, *June,* 1931.—The chief limitation in sensitivity of a Wheatstone bridge is set by the instrument used to indicate when the bridge is balanced. It is suggested that the sensitivity may be increased by connecting the potential ends of the bridge to the grids of two triodes, the plates of which are connected together by a resistance of which the centre is connected to the h.t. supply. When the bridge is unbalanced, a galvanometer connected between the plates will show a deflection, which becomes zero when the bridge is balanced. The valve arrangement may also be used as an amplifier if a suitable string electrometer is substituted for the galvanometer. G. E. B.

**3960. Bridge for the Measurement of the Conductance of Electrolytes. P. H. Dike.** *Rev. Sci. Instruments,* 2. *pp.* 379–395, *July,* 1931. An account in detail of the construction of a bridge suitable for the measurement of electrolyte conductance, and operating at frequencies up to several thousand cycles per second. The chief feature of the bridge is that the components (resistances, condensers, etc.) and the layout are designed to reduce frequency error to the smallest possible amount. For resistances between 10 and 60,000 ohms an accuracy of about 0·02 % is claimed by direct reading, while by applying suitable precautions the accuracy can be increased to within ± 0·005 %. G. E. B.

**3961. Simple Time Meter. H. B. Brooks.** *Rev. Sci. Instruments*, 2. *pp*. 348–351, *June*, 1931.—The instrument has been made to integrate intermittent periods of time, as required, for instance, in testing the life of lamps and similar work. It consists essentially of an ordinary self-starting electric clock operating on a controlled synchronous frequency, a suitably-geared direct-reading meter being substituted for the 12-hour dial. As completed the meter operates on a supply of 60 ∼, 110 volts and reads a total of 10,000 hours directly to 0·1 hour, or by estimation to 0·01 hour. G. E. B.

**3962. Automatic Adding and Registering Machine for Electron Counting Experiments. H. Neufeldt and W. Voss.** *Phys. Zeits*. 32. *pp*. 453–454, *June* 1, 1931.—A description is given of a high-velocity adding and registering apparatus which has been especially constructed for use in conjunction with the Geiger point counter or the Geiger-Müller electron counter. The machine has many advantages over the simple adding processes, the chief of which is that it can be worked continuously for several days at a time. H. L. B.

**3963. Calculation of Large Electromagnets. L. Dreyfus.** *Arch. f. Elektrot*. 25. *pp*. 392–410, *June* 19, 1931.—The calculations are made on the large electromagnet of the Paris Academy [see Abstract 3304 (1928)]. Details of the electromagnet are given, and differential equations are found for the distribution of the induction in the pole-pieces and pole-gaps. Conclusions are drawn as to the most favourable form for the pole-pieces and for the dimensions of the pole-cores. G. E. A.

**3964. Application of the Metallic-Oxide Rectifier to the Measurement of Peak Potentials. M. Robert.** *Comptes Rendus*, 192. *pp*. 1539–1540, *June* 15, 1931.—The application of the metallic-oxide rectifier to the measurement of peak and mean potentials is very briefly described. Essentially the arrangement comprises a rectifier in series with a condenser and shunted by a microammeter and adjustable resistance. J. S. G. T.

**3965. Method of Measuring Intense Direct Currents. C. Dietsch.** *Comptes Rendus*, 193. *pp*. 22–24, *July* 6, 1931.—The principle of the method depends on the fact that the characteristics of a transformer used in measuring a.c. are greatly modified by changes in the magnetic state of the core. If a toric transformer is set up to be used in some measurement employing a zero method, and a balance is obtained, an intense steady current $I_1$, in a neighbouring conductor will upset the balance, and an a.c. galvanometer will show a deflection. By passing a steady current $I_2$ through a third coil of *n* turns wound on the transformer, equilibrium may be restored, and $I_1 = nI_2$. This result is modified by the hysteresis of the core, but by the use of certain precautions a current of several thousand amperes may be measured to 2 or 3 parts in a thousand. G. E. A.

**3966. Valve Microvoltmeter. E. Wöhlisch.** *Zeits. Instrumentenk*. 51. *pp*. 312–317, *June*, 1931.—The instrument has been used in physiology to measure the heat developed by muscular action. The causes of failure of earlier types of instrument are discussed. The instrument described has a rhythmic interrupter in the d.c. circuit from the thermal cell, and this l.f. current passes through a transformer. A frequency of 100 ∼ is used, and a transformer with a core of high permeability is employed. Taking the sensitivity $S_v$ as the deflection in mm. at 1 m. for a voltage of $10^{-6}$ and a period of oscillation $T_0$ the instrument gives $S_v = 200$ and $T_0 = 0{\cdot}01$ sec., while the highly sensitive Zernicke moving-coil galvanometer gives $S_v = 34$ and $T_0 = 7$. R. S. R.

**3967. H.T. Pendulum Voltmeter. W. Rogowski.** *Arch. f. Elektrot.* 25. *pp.* 521–522, *July* 15, 1931.—An illustrated description of a cheap and robust electrometer voltmeter for use up to 70 kV. The principle is that of the repulsion of two swinging arms, like two gold leaves in an electroscope. One arm carries a pointer which moves over a scale attached to the other arm. Provided stray fields are excluded, the deflection between the arms measures the voltage above earth. [See Abstract 3564 (1930).] L. E. C. H.

## RADIOGRAPHY AND ELECTROPHYSIOLOGY.

**3968. Spectral Erythemic Reaction of the Human Skin to Ultra-Violet Radiation. W. W. Coblentz, R. Stair and J. M. Hogue.** *Nat. Acad. Sci., Proc.* 17. *pp.* 401–405, *June*, 1931.—A description of experiments made to determine the spectral erythemic reaction of the untanned human skin and the energy required to produce a mild erythema. Isolated spectral lines from a large quartz monochromator were used as stimuli, and the time of exposure to produce a minimum perceptible erythema was determined. The source of light was a mercury arc, and the intensity of the lines was measured with a linear thermopile calibrated in absolute value. The wave-length region of erythemogenic reaction begins at 315 mμ and extends to an undetermined wave-length shorter than 240 mμ. The response curve rises abruptly to a maximum of 297 mμ, descends less abruptly to a minimum at 280 mμ and then rises to a less intense maximum in the region of 250 mμ. Experiments with the line 297 mμ confirmed the reciprocity law, exposures of twice and four times the length, to intensities of half and a quarter the intensities respectively, producing sensibly the same total effect. The energy required to produce a minimum perceptible erythema at a wave-length of 297 mμ is of the order of 500,000 ergs, actually the results obtained on three observers being 452, 514, and 645 kiloergs/cm.$^2$ The urgent need of standardisation in the therapeutic use of ultra-violet light is emphasised. W. V. M.

**3969. Measurements of Extreme Ultra-Violet Solar Radiation. W. W. Coblentz and R. Stair.** *Bureau of Standards, J. of Research,* 6. *pp.* 951–976, *June*, 1931.—Quantitative measurements are given of the component of ultra-violet solar radiation of wave-lengths less than 313 mμ. The method used is a type of filter radiometry, employing a non-selective thermocouple receiver, permanently covered with a filter that is highly transparent to short wave-length ultra-violet radiation and practically opaque to the visible and the infra-red rays. By temporarily placing in the path of the rays first one, then two screens of barium flint glass which is opaque to wave-lengths less than 313 mμ, the ultra-violet of wave-lengths less than 313 mμ is evaluated by exclusion from the total ultra-violet measured. Measurements are given of the incident ultra-violet solar radiation on the clearest days, as affected by atmospheric pollution, altitude of the station, humidity, time of the day, and season of the year. These data are discussed and correlated with some of the measurements and calculations made by others. [See also Abstract 1621 (1930).]

AUTHORS.

**3970. New Osram Protected X-Ray Tube. W. Traub.** *Zeits. f. techn. Physik*, 12. 5. *pp*. 265–267, 1931.—This tube is made in two parts, an internal discharge tube and an outer sleeve. The inner tube which is of a molybdenum glass contains the water-cooled target of the usual tungsten-in-copper type at 45° to the kathode rays and the hot kathode which is of the spiral type. In the neighbourhood of the discharge space are two metal cylinders, one inside the tube and one immediately outside. The cylinders are not connected to either electrode, and assume a potential higher than the kathode potential by about $\frac{1}{8}$, *e.g.*, in a tube operating at an anode potential of + 100 kV and a kathode potential of − 100 kV, the potential of the metal cylinders is about − 70 kV. The kathode head has a tungsten disc to intercept unwanted radiation from the anode, while the general protection against unwanted radiation is afforded by first the molybdenum glass, and then the outer sleeve which has a lead central cylinder and lead glass arms. G. E. B.

**3971. X-Ray Apparatus for a Tube Voltage of 600 kV. K. W. Müller.** *E.T.Z.* 52. *pp*. 859–861, *July* 2, 1931.—A description and particulars of test are given of an X-ray apparatus to operate at a tube voltage of 600 kV, which is installed at the Charité Hospital in Berlin. The superior penetration of radium $\gamma$-rays over X-radiation, as regards penetration and depth dosage, is mentioned. Equivalent advantages would be obtained with X-ray apparatus operated at 1000 kV, and an attempt towards this has been made by the present apparatus. It was found that tubes designed to operate at 220 kV could actually be operated at 460 kV if suitably prepared. With such a tube, when operated at 250 to 280 kV, the operation became unsteady, but, if the operating voltage was then slightly reduced and the tube operated for a time varying between half an hour to one hour, when the voltage was again raised, it could be operated quite steadily with an additional 20 to 30 kV. Such seasoning eventually allowed a voltage as high as 460 kV, which is attributed to improvement of the vacuum. A schematic arrangement is given of the h.t. generator, which is based on the Villard connection, with the mid-point of the two transformer secondaries earthed and various test curves of the operation of the transformers on no-load and on load are illustrated, together with the lead absorption curves of the radiation emitted. To protect the personnel from such radiation at 400 kV a lead absorption value of 14·5 mm. is necessary. B. J. L.

**3972. Adjustable Leak for X-Ray Tubes. H. Kersten.** *Rev. Sci. Instruments*, 2. *pp*. 377–378, *July*, 1931.—A form of "needle-valve," detailed drawings of which are given. G. E. B.

**3973. Ionisation Chambers for X-Ray Dosage Measurement. E. A. Owen and H. I. Jones.** *Brit. J. of Radiology*, 4. *pp*. 309–338, *July*, 1931.—An ionisation chamber of the parallel plate type is described suitable for the absolute measurement of X-ray intensities; the range over which its indicators are reliable is determined and discussed. Various forms of graphite walled ionisation chambers are described. It is shown that small chambers may yield spurious indications owing to the influence of radiations scattered from the chamber walls in the region round the collecting electrode external to the chamber body. Methods are given by which the source of error is eliminated. It is then found that, over the range of operating voltages of the source from 40 to 110 kV, the ionisation in these chambers is proportional to the volume of the air cavity, if cubical in shape. The indications of the air and graphite chambers are compared under specified conditions. It is shown that it is undesirable to employ the graphite walled chambers in a form yielding absolute intensity values directly because of difficulties in preparing suitably thin homogeneous graphite plates. Values of the ratio of graphite walled chamber dose to absolute air-chamber dose are given. W. V. M.

**3974. X-Ray Stabilisers. R. S. Wright.** *Brit. J. of Radiology*, 4. *pp.* 339–348; *Disc.* 348–350, *July*, 1931. *Paper read before the Soc. of Radiographers.*—The current through an X-ray tube varies very rapidly with the temperature of the tube filament, hence on fluctuating mains it is necessary to control accurately the filament current. Various devices for doing this are discussed in the present paper, including the Kearsley stabiliser (which is operated by the tube current), and several arrangements for maintaining constant filament current based on the physical properties of a.c. networks containing choke coils with nearly saturated cores. A new arrangement in which the constancy of filament current is maintained by means of a hot-kathode thyratron is also mentioned. G. E. B.

**3975. Influence of X-Rays upon Bacterial Dissociation. C. E. Rice and G. B. Reed.** *Canad. J. of Research*, 5. *pp.* 122–128; *Disc.*, 128–129, *July*, 1931.—It is shown that X-ray treatment of cultures of a rapid-growing strain of bovine tubercle bacillus showing a tendency to change from R to S promoted the change to a considerable degree. Stable R cultures of the same species are unaffected. Larger doses produce a lethal effect. Protective colloids such as gelatin or blood serum added to the suspension reduce the effect of the irradiation. Non-acid-fast bacteria are shown to be much less sensitive to the effects of X-rays, as no change in the rate of dissociation has been observed in actively dissociating cultures with twice the dosage to which tubercle bacilli were exposed. AUTHORS.

**3976. Use of Radon as an Indicator in Diagnosis and Therapy. Investigations on Respiratory Processes. S. Meyer and E. Suess.** *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp.* 613–628, 1930.—The emanation content in exhaled air has been investigated after drinking water containing radon. For normal healthy subjects with normal frequency of breathing a definite curve is obtained representing the radon content with time after taking the water. This curve shows a rapid rise to a maximum which is reached more quickly the greater the pulse-frequency. For instance, for 60 beats per min. the time is 30 min. to reach the maximum while for 95 beats per min. only 5 min. is required. The fall has a half value of from 15 to 45 min. Diseased persons show a delay in the appearance of the maximum for a given pulse rate. Patients with artificial pneumothorax show a much more rapid fall in radon content after the maximum. Normal persons with very small respiratory rates showed marked deviations of curve form while important changes, as in bronchitis or tuberculosis, lead to erratic single values from which a curve cannot be constructed. W. V. M.

## CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

**3977. Adsorption by Silica from Non-Aqueous Binary Systems over the Entire Concentration Range. F. E. Bartell, G. H. Scheffler and C. K. Sloan.** *Am. Chem. Soc., J.* 53. *pp.* 2501–2507, *July,* 1931.—The interferometric method [see Abstract 3667 (1929)] has been used to measure changes in concentration of solutions and, in each system investigated, an S-shaped adsorption curve has been obtained. Over some portion of the concentration range each of the components was preferentially adsorbed. The adsorption curve obtained with silica as adsorbent is very nearly the inverted and reverse form of that obtained with carbon for the same binary liquid system. That component having the higher adhesion tension against the solid is preferentially adsorbed over the greater portion of the concentration range. The Freundlich equation, when so modified as to express the measure of adsorption in terms of change in concentration as $H\Delta x/m = ax^n(1-x) - b(1-x)^d x$, was found to express the adsorption as determined over the entire range of concentration. H. H. Ho.

**3978. Adsorption by Silica and Carbon from Binary Organic Liquid Mixtures over the Entire Concentration Range. F. E. Bartell and G. H. Scheffler.** *Am. Chem. Soc., J.* 53. *pp.* 2507–2511, *July,* 1931.—The monobasic alcohols of the saturated hydrocarbon series are preferentially adsorbed by silica from benzene over the greater portion of the concentration range and in an order decreasing as the molecular weight increases. The preferential adsorption by carbon from similar systems is in the same order, but of less magnitude, and occurs over but a limited portion of the concentration range. The modified Freundlich equation previously used [see also Abstract 3667 (1929)] is found to apply to the preferential adsorption effects for both the silica and the carbon adsorbents. The degree of adsorption of one component, the adsorbate, from a binary organic liquid system is dependent upon the adhesion tension of that component against the adsorbent as compared to the adhesion tension of the solvent against the adsorbent, and also upon the solubility of the adsorbate in the solvent. The effect of solubility is noted when a series of compounds of similar adhesion tensions against an adsorbent are adsorbed from a given solvent, such as benzene. The greater the solubility of the adsorbate, the less will be its tendency to be adsorbed. H. H. Ho.

**3979. Adsorption Processes in Dilute Non-Aqueous Solutions. L. Ebert and E. Waldschmidt.** *Zeits. f. phys. Chem. Bodenstein Festband, pp.* 101–112, 1931.—By measurement of the changes in dielectric constant it has been possible to measure the rate of adsorption and the equilibrium adsorption values of substances from benzene solution on charcoal or silica gel. It is important with this method to free the adsorbent very completely from traces of water. The effect of heating on the adsorptive power of various types of charcoal and silica gel has been studied. F. J. W.

**3980. Adsorption and Specific Reactions at Surfaces. H. S. Taylor.** *Zeits. f. phys. Chem. Bodenstein Festband, pp.* 475–480, 1931. *In English.*—The concept of activation energy of adsorption processes is discussed in reference to the problem of specific reactions at surfaces. It is shown that the velocities with which activated adsorptions of hydrogen occur on several surfaces are consistent with the known characteristics of such surfaces in dehydration-dehydrogenation reactions. The velocity of adsorption of oxygen on silver was measured. Activation energies of adsorption ranging from 5000–30,000 calories were indicated. F. J. B.

**3981. Energy Transference by Adsorbed Molecules. K. F. Herzfeld and M. G. Mayer.** *Zeits. f. phys. Chem. Bodenstein Festband, pp.* 669–678, 1931.—The transference of energy which takes place when a molecule is adsorbed by a crystal is investigated. It is assumed that the mutual reaction between the two could be treated as between two multipoles. In general more than one quantum must be removed from the crystal in order to activate the molecule. Changes of the Raman type involve frequent exchanges. F. J. B.

**3982. Exchange of Energy between Organic Molecules in a Molecular Beam and Metallic Surfaces. F. O. Rice and H. T. Byck.** *Roy. Soc., Proc.* 132. *pp.* 50–66, *July* 2, 1931.—When acetone or dimethylmercury in a molecular beam collides with a heated platinum target, no decomposition occurs up to temperatures of 1600° C. Adsorption on the surface of any appreciable fraction of the molecules for a time very long in comparison with the duration of a collision should cause detectable decomposition, which should have been observed if any considerable fraction of the molecules bounced round in minute surface crevices. It is, therefore, concluded that adsorption on the surface or the trapping of molecules in cavities does not occur to an appreciable extent when organic vapours at low pressures collide with heated metal targets. When acetone vapour comes into temperature equilibrium with a target at 1600°, the fraction of the molecules having the energy of activation 65,500 cal. is too small to be detected. Dimethylmercury should have a measurable fraction of activated molecules at this temperature, but as no decomposition is observed, it is concluded that the transfer of energy from a heated target to the internal degrees of freedom of an organic molecule is not 100 % efficient. When acetone or dimethylmercury in a molecular beam collides with a heated tungsten target no decomposition is observed up to 1085° C. At this and higher temperatures a surface reaction occurs in which tungsten carbide is formed and carbon monoxide and hydrogen are liberated. This heterogeneous surface reaction attains an appreciable rate only at about 1085° C. Similar results are obtained with a tantalum target except that the reaction did not commence until 1400° C. T. H. P.

**3983. Adsorption of Hydrogen. Part II. Maintenance of a Monomolecular Layer and Liberation of Recombined Atoms with Emission of Energy. M. C. Johnson.** *Roy. Soc., Proc.* 132. *pp.* 67–83, *July*, 1931.—By analysing curves of the fall of pressure in an electrodeless discharge, numerical values are obtained for the several processes contributing to the maintenance of a loosely packed layer of adsorbed hydrogen. It is found that a term representing liberation from the layer by recombination with an atom impinging from the gaseous phase decreases exponentially as the concentration in the surrounding layer increases; this is interpreted as indicating the existence of a bond causing an incipient tendency to self-constituted structure among the atoms in the adsorbed state. Among the consequences it is found that, for a given partial pressure of atomic hydrogen in the gaseous phase, the total emission of energy by recombination of atoms leaving the layer should increase as the initial temperature of the surface is raised, and should pass through a maximum. The existence of this maximum is verified experimentally by measurement of the heating of a tungsten wire, a method being devised to correct for the action of the wire as a Pirani gauge responding to the pressure changes which occur during adsorption. [For Part I see Abstract 3173 (1929).] AUTHOR.

**3984. Electrical Condition of Hot Surfaces during the Adsorption of Gases. Part IV. Carbon and Copper Surfaces at Temperatures up to 850° C. G. I. Finch and J. C. Stimson.** *Roy. Soc., Proc.* 132. *pp.* 192–200, *July* 2, 1931.—This paper continues a previous investigation [see Abstract 3117 (1929)] and establishes the following results: (1) A carbon rod does not exhibit constant and reproducible surface potential values until after the initial evolution of occluded gas has ceased. It is suggested that the emission of gas results in structural changes occurring in the surface and that such gas is probably chemically bound by the surface. (2) A copper sheet is not "normalised" until some time after the slight initial gas evolution has ceased, so that in this case sintering is probably taking place. (3) Copper oxide completely blankets the surface of the metal, so that it does not exhibit a surface potential either *in vacuo* or in contact with oxygen. (4) Evidence is obtained that the potentials of the charges acquired by any of the surfaces examined tend to approach towards zero as the "normalisation" temperature is increased. (5) It is found that at 850° C. the values of the surface potentials on all the metal surfaces fall into three distinct groups: (*a*) oxygen; (*b*) *in vacuo*, nitrogen, argon and carbonic oxide; and (*c*) hydrogen. At this temperature the specific effect of the surface appears to be very much reduced, and the value of the surface potential is largely determined by the nature of the gas with which the hot surface is in contact. H. H. Ho.

**3985. Surface Condition of Platinised Charcoal Due to the Simultaneous Presence of $H_2$ and $O_2$ and Mode of Action of the Active Centres. A. Frumkin, S. Lewina and O. Zarubina.** *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 41–50, *June*, 1931.—This work concerns adsorption from neutral salt solutions by oxygen containing platinised charcoal in a hydrogen atmosphere as well as in an oxy-hydrogen atmosphere. It is concluded that under these conditions all points on the surface have the same electrical potential. Unplatinised charcoal containing oxygen shows a positive potential in a hydrogen atmosphere while platinised charcoal under these conditions takes on the hydrogen potential and so becomes negative. By the introduction of quite small quantities of platinum into charcoal a continuous passing over between these two extremes can be observed. The present work indicates, furthermore, by the adsorption of neutral salt solutions, that every point on the surface has the same potential and not that some points are positively charged and others negatively at any particular moment. J. K.

**3986. Gas Content and Adsorption of Electrolytes by Active Charcoals. Part VI. B. Bruns and A. Pilojan.** *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 77–83, *June*, 1931.—The present work refers to the mechanism of the adsorption of strong acids by active charcoal in an oxygen atmosphere [see Abstracts 3571 (1930) and 1013 (1931)]. In the adsorption of acids by active charcoal gaseous oxygen is absorbed. On the desorption of charcoal containing the adsorbed acids it is found that the oxygen is not free but has combined with the charcoal to form a superficial oxide. J. K.

**3987. Heat of Adsorption of Hydrogen and Carbon Monoxide on Zinc and Chromium Oxide Catalysts. W. E. Garner and F. E. T. Kingman.** *Faraday Soc., Trans.* 27. *pp.* 322–333, *July,* 1931.—The vacuum calorimeter is used to determine the heats of adsorption and adsorptive capacity of hydrogen and carbon monoxide on catalytic surfaces of zinc oxide, chromium oxide and zinc oxide-chromium oxide. It is deduced that the greater efficiency shown by the mixed catalyst is due to an enlargement of the internal area of the catalyst. J. K.

**3988. Rate of Sorption of Ammonia on Meerschaum. M. G. Evans.** *Faraday Soc., Trans.* 27. *pp.* 333–340, *July,* 1931.—The attainment of equilibrium was not sufficiently rapid to be able to make use satisfactorily of the Bunsen ice calorimeter to determine the heat of sorption. It is found that the log $S/\log t$ curves are dependent on the temperature at which the meerschaum is outgassed. The log $S/\log p$ relationship is a linear one for a fairly large pressure range. A tentative theory to explain the peculiar rate curves is given, based upon the crystalline and gel constitution of meerschaum. J. K.

**3989. Phenomena Due to Forces at Crystal Faces: Mutual Orientation. C. A. Sloat and A. W. C. Menzies.** *J. Phys. Chem.* 35. *pp.* 2005–2021, *July,* 1931.—Royer's results [see *Comptes Rendus,* 180. *p.* 2050, 1925] are confirmed, but in addition thereto KCN, KBr, RbCl and RbBr orientate on galena, and KBr and KI on rock-salt, but not RbCl nor RbBr on the latter, though with less percentage difference of parameters than KI; this is attributed to the larger radius of the Rb ion and consequent diminished symmetry of the ion pairs Rb-Cl and Rb-Br. The maximum percentage difference in parameters is 25·25 % for rock-salt and 14·90 for galena. Deposition from organic solvents or vapour show orientating ability to increase as the dielectric constant of the solvent decreases; thus with acetone (dielectric constant, 21) RbI orientates on rock-salt (parameter difference 30·06 %) and on potassium chloride (16·56 %), and KI on galena (18·09 %). Orientation on galena is very sensitive to grease, for which it has a great attraction. For orientation on silver very slight parameter differences are tolerated—maximum 0·98 % with CsCl—due possibly to the positive charge of the silver atoms. Change in crystal habit is not due to orientated adsorption, but some solutions causing this produce characteristic etch figures. In no case did an electro- and a co-valent compound mutually orientate. C. A. S.

**3990. Adsorption of Solutes by Crystals and Compatibility of Space Lattice. C. A. Sloat and A. W. C. Menzies.** *J. Phys. Chem.* 35. *pp.* 2022–2025, *July,* 1931.—The adsorption from M/100 solutions of the bromides of Li, Na, K, Rb, Cs or $NH_4$ by artificial crystalline lead sulphide shows little, if any, relation to the lattice dimensions or structure of the adsorbed salt, or with the ability of the salt to orientate on galena. [See preceding Abstract.] C. A. S.

**3991. Solubility as a Complicating Factor in Adsorption Measurements. E. W. R. Steacie.** *J. Phys. Chem.* 35. *pp.* 2112–2117, *July,* 1931.—Complications have frequently been observed with gas-solid systems owing to slow and sometimes irreversible effects which are superimposed upon the ordinary rapid process of adsorption. The experimental evidence cited by Taylor in support of the hypothesis of an activation energy for the adsorption processes is re-examined and critically discussed. It is concluded that the irreversible adsorption and the slow effects accompanying adsorption processes are capable of explanation on the basis of existing data regarding the solubility of gases in solids. F. J. B.

**3992. Study of the Specific Surfaces of Powders by Optical Methods. G. I. Pokrowski.** *Kolloid Zeits.* 55. *pp.* 321–323, *June*, 1931.—In the formula $k = 1/(1 + S/Q)$, where $k$ is the reflection coefficient of the surface of the dispersoid, S is a constant and Q the specific surface, S is in general unknown. Relative measurements of active surfaces can, however, be made by determining $k$. The method is illustrated by results for the variation of $k$ with the variation of the water content of loam; if the soil is first wetted and then dried $k$ falls considerably owing to the capillary forces drawing the particles together and diminishing the active surface. A similar effect is produced if the soil is compressed by an external force. H. F. G.

**3993. Monomolecular Layers with Proteins. F. Herčik.** *Kolloid Zeits.* 56. *pp.* 1–7, *July*, 1931.—The monomolecular layers of serum, egg albumin, serum albumin and myoprotein, the properties of which are determined by the minimum surface tension method of du Noüy, are discussed. No connection can be established between the results given by this method and those obtained by the ordinary methods of Langmuir and Adams, probably owing to the fact that the latter deal with denatured protein layers. T. H. P.

**3994. Molecules in an Intense Centrifugal Field. T. Svedberg.** *J. de Physique et le Radium*, 2. *pp.* 227–236, *July*, 1931.—From a study of the behaviour of molecules in an intense centrifugal field, information is obtained concerning molecular weight, degree of homogeneity and degree of symmetry of molecules. The paper includes the theoretical treatment for the measurement of sedimentation equilibrium and the rate of deposition. A description is given of the installation for obtaining very intense centrifugal fields, and the experimental results for proteins are briefly indicated. H. H. Ho.

**3995. Osmotic Pressure of Dilute Benzene Solutions by the Porous Disc Method. W. C. Eichelberger.** *Am. Chem. Soc., J.* 53. *pp.* 2025–2036, *June*, 1931.—An apparatus is described by which it is possible to measure with a fair degree of accuracy the osmotic pressure of dilute solutions such as benzene solutions of tetraphenylethylene. A new type of thermoregulator employing a resistance thermometer and photoelectric cell is also described which permits the accurate control of the temperature of thermostats. A modification of mercury traps is employed in vacuum systems so as to eliminate the use of stopcocks and stopcock grease. J. K.

**3996. Osmometer for Lyophilic Colloids. R. O. Herzog and H. M. Spurlin.** *Zeits. f. phys. Chem. Bodenstein-Festband*, *pp.* 239–246, 1931.—An osmometer is described for lyophilic sols, especially for cellulose ester and ether. Results are given for solutions of benzylcellulose in methyl glycolacetate at 18°, 35° and 50° in concentrations from 0·1 to 30 %. J. K.

**3997. Viscosity and Rigidity in Suspensions of Fine Particles. Part I. Aqueous Suspensions. Part II. Non-Aqueous Suspensions. C. M. McDowell and F. L. Usher.** *Roy. Soc., Proc.* 131. *pp.* 409–427, *May* 1, *and pp.* 564–576, *June* 3, 1931.—Part I deals with the system of suspensions of electrically charged particles in an aqueous liquid. Reference is made to the work of Humphrey and Hatschek on suspensions of electrically uncharged particles in neutral organic liquids. The present investigations show that sols of copper ferrocyanide, when stable, possess a constant viscosity coefficient differing little from that of water. This viscosity coefficient also increases with decreasing rate of shear when rendered unstable by the addition of an electrolyte. It has also been found that under certain conditions these sols and those of CdS are definitely rigid. Cupric ferrocyanide and cadmium sulphide are, unlike gelatin and other "emulsoids," definitely insoluble in water and form typical fine aqueous suspensions sensitive to electrolytes. The general results obtained for these two substances are in agreement in so far as comparison is possible. It is observed, however, that the development of rigidity in suspensions of CdS require a greater volume percentage of solid than with copper ferrocyanide. It is considered that the shear-variable viscosity exhibited is due to the formation of loosely packed aggregates which enclose varying quantities of the dispersion medium. Part II gives evidence of a more complete character than that given in the earlier paper. It deals with the microscopic examination of suspensions of visible particles in inert organic liquids and the correlation of these results with those on viscosity and rigidity. It is considered that the following generalisation may be made, namely, that if rigid particles suspended in a liquid in which they are insoluble are not prevented from cohering—whether by an electric charge or by an envelope of a soluble substance—before long they will form aggregates, and these will always cause the viscosity to be a function of the rate of shear; and if these are completely interlinked, will cause rigidity to the suspension as a whole. J. K.

**3998. Photophoresis in Suspensions and Suspensoids. G. Fachini.** *Kolloid Zeits.* 56. *pp.* 40–45, *July*, 1931.—This experimental study has shown the formation of a typical conical turbid arrangement of condensed particles, in all cases the apex of the cone being directed towards the surface. The optimum period of cone formation was about 14 hours, and for 250 watts absorbed from the source of light. Precautions to avoid convection movements were taken. The unequal distribution of the disperse phase in the dispersing medium produced by the photoeffect and at the isoelectric pH, is explained as a photophoretic effect. H. H. Ho.

**3999. Influence of Light on the Flocculation of Colloidal Solutions in Fluorescent Media. Rôle of Coloured Inhibitors and of the Viscosity of the Medium. A. Boutaric and J. Bouchard.** *Comptes Rendus,* 193. *pp.* 45–46, *July* 6, 1931.—Continuing previous work [see Abstract 2478 (1931)] it is shown that coloured substances which inhibit fluorescence in a given case at the same time reduce the flocculating power of the fluorescent substance. Increase of viscosity which diminishes fluorescing power also diminishes the flocculating effect of the fluorescent substance. J. E.

**4000. Difform Systems. Part I. Stereometric and Systematic Difform Systems. W. Ostwald.** *Kolloid Zeits.* 55. *pp.* 257–272, *June,* 1931.—A theoretical paper dealing with such matters as coarse and discrete discontinuity, medium or colloidal discontinuity, stereometric transformation between coarse and discrete discontinuity. Numerical examples of difformation are given. Reticular, spongoid and porous systems are discussed as well as systematic difform systems according to their state of aggregation. J. K.

**4001. Preparation of Gold Sols by Reduction with Hydrogen. Influence of Visible Light on Sol Formation. A. Schmidt.** *Kolloid Zeits.* 55. *pp.* 333–341, *June,* 1931.—It is shown that visible light has a very strong effect on sol formation by reduction of gold compounds with hydrogen and that this must be taken into account if similar sols are to be obtained. Light, temperature and alkalinity have an influence on the sol formation process. J. K.

**4002. Cobalt Sulphide Bands in Solid Silica Gel. E. R. Riegel.** *J. Phys. Chem.* 35. *pp.* 1674–1683, *June* 1931.—It is shown that cobalt sulphide bands can be developed in solid silica gel by covering the solid gel containing cobalt nitrate with sodium sulphide solution, or with a more hydrous silica gel containing sodium sulphide. Flat pyrex tubes are described which permit observation with a low-power microscope. J. K.

**4003. Measurement of Particle Size of Nitrocellulose Dispersion. H. B. DeVore and W. P. Davey.** *J. Phys. Chem.* 35. *pp.* 2129–2130, *July,* 1931.—Reference is made to a water-spreading method of measuring the particle size of the disperse phase of a colloid previously described by Davey. In the present work a sample of nitro-cotton dispersed in ethylacetate is employed. It is believed from the results obtained that the ultimate particles in a nitrocellulose dispersion are not greatly different in size from the unit cell of cellulose or of nitrocellulose. J. K.

**4004. X-Ray Studies of Cellulose Derivatives. Part X. K. Hess and C. Trogus.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 385–391, 1931.—It is shown that for cellulose and its derivatives the fibre period is always equal to an integral multiple of 5·15 Å.; the integers are 2, 3, 4 and 5. The value 5·15 Å. corresponds to the length of the glucose molecule, and it is concluded therefore that substitution processes in cellulose leave not the cellobiose residue intact, but the glucose residue. The period 5·15 Å. has therefore a more important relationship to the constitution of cellulose than the value 10·3 Å. hitherto taken as fundamental. F. J. W.

**4005. Micelle Structure of Wool Fibre. J. B. Speakman.** *Roy. Soc., Proc.* 132. *pp.* 167–191, *July* 2, 1931.—It has been found that the wool fibre is constructed from micelles which are lamellar in shape and arranged with their long axes parallel to the length of the fibre, being probably ten times longer than they are thick; the order of thickness is 200 Å. The intermicellar distance in the case of the dry fibre is small (about 6 Å.), but in water this distance is increased by swelling to 41 Å., and renders the swollen fibre more easily accessible to reagents of high molecular weight. The internal surface of the fibre is of the order $1 \times 10^6$ cm.$^2$/gm. It is found that the total amount of intermicellar water adsorbed by wool from saturated air is 20·5 % of the dry weight (compare

21·6 % as deduced from a change in rigidity with water adsorption). Acids have a marked destructive action on the micelles, and, to a certain extent, free the long-chain protein molecules within the micelles from one another, thereby facilitating the extension of the fibre. This change is reversible, so that when the fibres are washed free from acid in water the original elastic properties are recovered. Attack of the micelles by acid proceeds from the same thin edges which are attacked by sodium-sulphide solution. H. H. Ho.

**4006. Use of the Ultramicroscope for Observing Smoke Particles Falling on Liquid Films. P. D. Watson and A. L. Kibler.** *J. Phys. Chem.* 35. *pp.* 2125–2128, *July*, 1931.—An arrangement of the ultramicroscope suitable for the observation of liquid films is described. This has been employed for the examination of the behaviour of various types of smoke particles in the neighbourhood of oil and water films. C. B. A.

**4007. Magnesium and Magnesium Alloys. E. Schiebold and G. Siebel.** *Zeits. f. Physik*, 69. 7–8. *pp.* 458–482, *May* 28, 1931.—A method of preparing single crystals of magnesium by drawing out of a fused electrolyte is developed. The molten magnesium is protected by fused carnallite, and a graphite tube, protected by an iron tube, is lowered into the molten metal. The two tubes are then raised slowly, the metal allowed to solidify, and the graphite tube broken away from the magnesium rod. Solution experiments showed that the magnesium crystals were more strongly attacked in one direction to the axis than to another. The twinning of the crystals was examined, and the effects of work, both hot and cold, upon the crystal structure was studied. Debye-Scherrer diagrams of magnesium in various conditions of work, at right angles and parallel to the direction of work, were obtained. The results yield considerable information on the changes which take place during the working of magnesium. F. J. B.

**4008. Cold-Working of Platinum Wires. G. Greenwood.** *Zeits. f. Krist.* 78. 3–4, *pp.* 242–250, *June*, 1931.—The cold-working of platinum in the form of wire has been shown to produce a fibrous texture. Platinum resembles the other face-centred cubic metals, more especially aluminium, the crystallites arranging themselves so that the [111] direction is parallel to the direction of the force applied in the drawing process. X-ray photographs show a slight asymmetry, proving that the texture is somewhat conical in nature. The texture at various depths in the wire was investigated by using rays of different penetrative powers. It was found that the interior zones of the wire were more susceptible than the outer zones to the effects of cold-drawing. A determination of the side of the unit-cell of platinum, by the use of Kettmann's method, gave $a = 3\cdot912$ Å. [See also Abstract 1629 (1930).] AUTHOR.

**4009. Borders of Metallography. K. Schröter.** *Zeits. f. Metallkunde*, 23. *pp.* 197–201, *July*, 1931.—The sintering of powdered tungsten and the recrystallisation phenomena in a thin tungsten wire have been studied. The structure of layers of nickel on iron and copper on thin nickel-iron wires has also been investigated. It is further shown how metallographic investigations may be applied to glass. F. J. W.

**4010. Contraction of Metal Test-Pieces under Tensile Stress. E. Schapitz.** *Zeits. f. Physik*, 70. 9–10. *pp.* 641–661, *July* 22, 1931.—Cylindrical specimens of various metals are subjected to tensile stress which gradually increases to the breaking stress. With the object of studying the formation of the waist-like contraction which occurs before breaking, the diameters at many points along the bar are measured at short intervals of time, the longitudinal extensions being read at nearly the same instant. At large loads, distinctly less contraction is observed within a few centimetres from the end of the specimen. This sometimes has the effect of diverting a threatened break to a region nearer the middle. The position at which the " waist " finally develops depends partly on this stiffening, and partly on chance flaws. A more detailed research traces the order of events just before the maximum load is attained, and records both the contraction and the rates of contraction at different parts. Most of the observed phenomena can be broadly accounted for by a theory whose chief assumption is a viscous resistance proportional to the rate of change of strain. Finally, graphs of the longitudinal contours of the deformed test-piece are given for a succession of loads, and formulæ for their shape discussed. The onset of flow and of local contraction are gradual, and no characteristic constant can be derived from the observations. J. P. A.

**4011. Hexagonal Nickel. G. Bredig and E. S. v. Bergkampf.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 172–176, 1931.—Non-magnetic hexagonal nickel prepared by kathodic disintegration in hydrogen can be converted easily to the normal magnetic form by gentle heating in hydrogen. The hexagonal form can also be prepared by kathodic disintegration in nitrogen. F. J. W.

**4012. Sphere of Molecular Action of Metals. C. Benedicks.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 379–384, 1931.—The radius of the sphere of molecular action is calculated for thirteen metals. The metals are K, Na, Hg, Pb, Sn, Cd, Zn, Al, Ag, Au, Cu, Pt, Fe. The calculated values are in agreement of order with the apparent atomic radius of Bragg. The radius shows a periodic dependence upon the atomic number, and the variations are greater than for the atomic radius of Bragg. Conclusions are drawn on the mechanism of the action of cohesion forces. F. J. B.

**4013. Properties of Grey, Austenitic Cast Iron. M. Ballay.** *Comptes Rendus,* 193. *pp.* 47–49, *July* 6, 1931.—The austenitic structure in cast iron is obtained by the addition of nickel either alone or together with other elements. In this paper the influence of the addition of various amounts of copper, aluminium or chromium on the properties of this type of cast iron has been investigated. Copper reduces the velocity of corrosion of this cast iron by 10 % sulphuric or hydrochloric acids, the extent of the reduction increasing to a constant value as the copper content increases to 5 %. Chromium and aluminium similarly reduce the corrosion by nitric acid. The rate of oxidation of austenitic cast iron is much reduced by the addition of either copper, chromium or aluminium. F. J. W.

**4014. Equilibrium Diagram of Copper-Tin Alloys. M. Hamasumi and S. Nishigori.** *Tôhoku Univ., Technol. Reports,* 10. 1. *pp.* 131–187, 1931. *In English.*—Gives the results of an examination of the copper-tin alloys containing from 15 to 41 % of tin, which suggest certain changes in the diagram. Two intermetallic compounds are found in this range, namely, $\delta$ with a formula $Cu_{31}Sn_8$, formerly considered to be $Cu_4Sn$ and $\eta$, $Cu_3Sn$ which undergoes a transformation at 675° to the solid solution $\gamma$; this compound has a freezing interval of about 20°, it does not crystallise primarily from the melt, but is formed from solid solution. There are three eutectoid transformations at 510°, 570° and 630°, and two peritectic transformations at 580° and 625°. A new phase $\epsilon$ is described as found between 630° and 570°. C. O. B.

**4015. Heat Conductivity, Electric Conductivity and the Lorenz Number of Several Light Metallic Alloys. W. Mannchen.** *Zeits. f. Metallkunde*, 23. *pp.* 193–196, *July*, 1931.—The heat conductivity, electric conductivity and Lorenz number have been measured for a number of alloys of aluminium and magnesium with other elements over the temperature range − 190° to 200° C. F. J. W.

**4016. Soil Corrosion and Pitting of Bare Ferrous Pipe Materials. K. H. Logan and V. A. Grodsky.** *Bureau of Standards, J. of Research*, 7. *pp.* 1–35, *July*, 1931.—During 1930 the National Bureau of Standards removed from seventy test locations approximately 1300 specimens of ferrous pipe materials. This paper reports the results of the examinations of these specimens. The extent of the corrosion is found to depend largely on the character of the soil. Rates of corrosion appear to vary somewhat from year to year, but the general tendency is for the rate to decrease as the time of exposure increases. The data do not indicate that there is one best pipe material regardless of soil conditions. The material which appears best in one soil may appear inferior in another soil. It is too early to state whether this will hold true at the close of long-time tests. Supplementary tests indicate that at least a number of soils have characteristic corrosive properties which can be expected wherever those soils are found. AUTHORS.

**4017. Nature of Surface Layer on Passive Iron. W. J. Müller and W. Machu.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 687–703, 1931. —The various methods of producing the passive surface layer on iron are described. The production of the passive state of iron in electrolytes containing sulphate ions was taken as a typical example. The production of the surface layer during its formation was investigated by a combination of the measurement of the time of production of the passive state and of the changes which took place during the "passivation." The changes were investigated by means of a polarisation reflection microscope. The oxide layer which caused the passivity of the iron was removed by alternate activation and passivation and at the same time brushing the iron electrode in strong sodium-sulphate solution. The surface layer was considered to be formed through the agency of a strongly double-refracting salt, which was probably the hepta-hydrate of ferrous sulphate. F. J. B.

**4018. Reaction Velocity in Relation to the Concentration and Activity of the Reactants. H. M. Dawson.** *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 230–234, *May*, 1931.—Consideration of published data relating to the hydrolysis of ethyl acetate in presence of hydrochloric acid and of the transformation of *N*-chloro- into *p*-chloro-acetanilide leads to the conclusion that reaction velocity is determined by the concentrations and not by the activities of the reactants. H. F. G.

**4019. Discontinuity in the Velocity Coefficient of a Chemical Reaction at the Critical Temperature. H. S. Sutherland and O. Maass.** *Canad. J. of Research*, 5. *pp.* 48–61; *Disc.*, 61–63, *July*, 1931.—An account is given of an hypothesis dealing with the mechanism of chemical reactions. This hypothesis was the *raison d'être* for the experimental work, which consisted in measuring the rate of a chemical reaction in a system over a temperature range including the critical temperature, and under conditions such that there is a continuity of concentration, when passing from the liquid to the gaseous state of aggregation. An experimental technique for the investigation of reaction mixtures under high pressures and at relatively high temperatures is developed. This method includes several new features which should find considerable application in investigations of this kind. In the reaction investigated, *viz.*, that between propylene and hydrogen chloride, it is conclusively shown that the velocity of the reaction increases with rise in temperature in the liquid state, and that above the critical temperature the velocity of the reaction becomes practically zero. A new hypothesis is put forward with the object of suggesting further work. It depends on regional orientation of molecules in the liquid state which undergoes a rapid diminution at the critical temperature. AUTHORS.

**4020. Energy of Activation for Bimolecular Reactions. H. Eyring.** *Am. Chem. Soc., J.* 53. *pp.* 2537–2549, *July*, 1931.—Application of the adiabatic (London) theory of reaction rates to reactions involving four atoms shows unambiguously that the thermal reaction of hydrogen with iodine will involve only iodine molecules, whilst the other halogens will react with hydrogen by way of atoms. It shows also that the conversion of para- to ortho-hydrogen will involve an atom and a molecule rather than two molecules, and it explains the well-known greater reactivity of the heavy halogen compounds over the lighter ones. These checks with experimental results are independent of the ratio of coulombic to total binding except in the case of bromine. If the known theoretical ratio of coulombic to total binding for hydrogen is assumed to hold for the other atoms, approximate agreement with experimental data is obtained. To reach exact agreement in the reaction $H_2 + I_2 = 2HI$, the coulombic binding must be assumed to be only 3·5 % of the total binding. The theoretical evaluation of the coulombic binding is possible, but difficult, by using the approximate eigenfunctions of Zener [see Abstract 3937 (1930)] and Slater [see Abstract 3938 (1930)]. T. H. P.

**4021. Determination of the Course of Heterogeneous Catalytic Reactions by the Measurements of the Resistance to D.C. of Metallic Powders during the Process. L. Reichardt.** *Zeits. f. Elektrochem.* 37. *pp.* 289–306, *June*, 1931.—Two types of heterogeneous catalytic reactions with Ni, Cu and Ag as catalysts are followed. The hydration of a hydrocarbon gave only small, while the reduction of an aromatic nitro body, on the other hand, gave large increases in resistance. Adsorption and capillary condensation influence the resistance only to a small extent. On the other hand, a small quantity of surface oxidation has a very prominent effect. The apparatus is described in detail, and tables of results are given and discussed. J. K.

**4022. Formation of Para-Hydrogen under Pressure at Low Temperatures. A. Farkas and K. F. Bonhoeffer.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 638–640, 1931.—It is shown that the formation of para-hydrogen at low temperatures under the application of pressure is a wall reaction and not a homogeneous reaction. J. K.

**4023. Flame Propagation through Dry Carbon Monoxide-Oxygen Mixtures in an Electric Field. W. A. Bone, R. P. Fraser and W. H. Wheeler.** *Roy. Soc., Proc.* 132. *pp.* 1–10, *July* 2, 1931.—Further experiments on intensively dried $2CO + O_2$ mixtures [see Abstract 3430

(1929)] show that imposition of an electrostatic field has a decided influence on the combustion, this being in opposite senses according as the flame first enters across its negative or positive boundary. In comparison with those of the control experiment (without field), the conditions near the negative pole are much more, and those near the positive pole rather less favourable to continuance of the flame. This may be ascribed to the fact that a flame is a highly " ionised " region, and that imposition of a field thereon causes a segregation of positive ions towards the negative pole, and of negative particles (chiefly free electrons) towards the positive pole, there being thus a general drift of the gaseous medium towards the negative pole. Marked striæ, which are rendered evident by the photographic method used and are never seen in the " fieldless " combustion of a dry $2CO + O_2$ medium, are evidence of such drift. Moreover, with a flame moving from − to + in an electric field, the tendency will be for the positive ions to be kept either in the region of active combustion or just behind it, whereas with the oppositive motion of the flame they will be drawn quickly out of it into the unburnt medium ahead. Assuming such positive ions (*e.g.*, $CO^+$) to be favourable to combustion, the flame will move faster in the former than in the latter case, which actually happens. When the flame is initiated midway between the two boundaries of a field, a distinction must be drawn between the conditions obtaining (1) during the first period when the flame is being propagated through the dry medium in which the field is maintained, and (2), subsequently, when the flame fronts have nearly reached the poles and the field breaks down. The fact that during (1) combustion is always maintained the better in the flame travelling towards the negative pole of the field may be ascribed to the combined effects of the two courses mentioned above. As soon as the field breaks down, combustion should be accelerated by the highly ionised condition of the medium, and it appears from the results that such condition largely overcame the resistance to combustion offered by the extreme dryness of the medium. T. H. P.

**4024. Differential Heat of Dilution and the Electrocaloric Effect. G. Jung.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 298–302, 1931.—A mathematical paper. The differential heat of dilution contains a factor which is to be included in the electrocaloric effect. [See also Abstract 3157 (1929).] J. K.

**4025. Apparent and Partial Molal Heat Capacities in Aqueous Solutions of Uni-univalent Strong Electrolytes. F. D. Rossini.** *Bureau of Standards, J. of Research,* 7. *pp.* 47–55, *July,* 1931.—$\Phi_c$, the apparent molal heat capacity of the solute, is shown, within the accuracy of the best experimental data, to be a linear function of the square root of the molality for aqueous solutions of uni-univalent strong electrolytes from infinite dilution to about 2·5 molal. Consequently, $\overline{C_{p2}}$, the partial molal heat capacity of the solute, and $\overline{C_{p1}}$, the partial molal heat capacity of the $H_2O$, are linear functions of the square root of the molality and the 3/2 power of the molality respectively. In convenient form are tabulated data from which may be quickly computed values of $\Phi_c$, $\overline{C_{p2}}$ and $\overline{C_{p1}}$ for aqueous solutions of the chlorides, bromides, iodides, nitrates and hydroxides of hydrogen, lithium, sodium and potassium for any molality in the given range, at 18°, 21·5° and 25° C. [See also Abstract 2597 (1930).] AUTHOR.

**4026. Heat of Ionisation of Water. R. H. Lambert and L. J. Gillespie.** *Am. Chem. Soc., J.* 53. *pp.* 2632–2639, *July,* 1931.—The heat of neutralisation at constant concentration is defined to be the heat effect ($-\Delta$H) of the reaction $\mathrm{MOH}\,.\,x\mathrm{H_2O}+\mathrm{HB}\,.\,x\mathrm{H_2O}=\mathrm{MB}\,.\,x\mathrm{H_2O}+(x+1)\mathrm{H_2O}$. Using the exact heats of neutralisation and of dilution determined by Richards, Rowe, Hall, Gucker and Mair (1920–1929), it is found possible to extrapolate satisfactorily such heats of neutralisation to the same point at infinite dilution for 6 inorganic salts (K, Na and Li chlorides and nitrates), $\sqrt{1/x}$ being taken as abscissa. The value 13,650 20°-gm. cal. (or 57·07 kilojoules) found by Richards and Hall for the heat of neutralisation at 20° at infinite dilution in the case of sodium chloride is found to be an excellent extrapolated value for the family of six curves, and it may be taken as the heat ($-\Delta$H) of the formation of water from its ions at 20°. This is in agreement with the conclusion of Richards and Mair, who introduced, however, bending in the plots in the region of extrapolation and gave considerable weight to the heats for sodium acetate, neither of which is now done. For the temperature coefficient of the heats, individual extrapolations for the various salts are not found possible. When the average values for the six inorganic salts are plotted, the temperature coefficients at constant concentration are distinctly a smoother function of the concentration or of its square root. The temperature coefficient of the heat of formation of water from its ions ($-d\Delta\mathrm{H}/dt$) is estimated to be $-$ 52 cal., or $-$ 217 joules per degree in the neighbourhood of 20°. T. H. P.

**4027. Effect of Foreign Gases on the Lower Critical Oxidation Limit of Phosphorus Vapour. H. W. Melville and E. B. Ludlam.** *Roy. Soc., Proc.* 132. *pp.* 108–126, *July* 2, 1931.—The effect of different gases and vapours on the lower critical oxidation limit of phosphorus vapour has been investigated in order to test the equation originally proposed by Semenoff [see Abstract 1081 (1928)]. It has been found that although the equation represents the results satisfactorily, the slope of the curve obtained by plotting the reciprocal of the critical oxidation pressure against the quantity $1 + p_x/(p_0 + p_\mathrm{P})$ depends on the nature of the gas. ($p_x$, $p_\mathrm{P}$, $p_0$, are the pressures of foreign gas, phosphorus and oxygen.) From the results obtained it is concluded, in the present approximate state of the theory, that the differences are to be explained on the variation of the diffusion coefficient (D) of the chain propagators into the foreign gas. Empirically the equation is modified to $p_0 p_\mathrm{P}\{1+\mathrm{D}p_x/(p_0+p_\mathrm{P})\}=\mathrm{constant}$. The results therefore show no correlation with those obtained for foreign gases at the upper critical oxidation limit. Evidence from the variation of the slopes of the curves with temperature confirms the opinion that variation of the diffusion coefficient is the predominating cause of the differences obtained. AUTHORS.

**4028. Temperature of Deflagration of Colloidal Powders. A. Michel-Lévy and H. Muraour.** *Comptes Rendus,* 193. *pp.* 40–42, *July* 6, 1931.—In view of the great variation in deflagration temperature according to rapidity of heating the most satisfactory temperature is that obtained by rapid heating (in 50 to 70 sec.) of 1–2 mg. of explosive, for which an arrangement giving constant results is described. Most nitrocellulose and nitroglycerin powders, as also those containing centralite, deflagrate at 199–203°; a non-gelatinised mixture of nitrocellulose and nitroglycerin at 197°, pure nitroglycerin at 206°, tetranitropentaerythrite at 213°, and an

unstabilised gun-cotton at 154°. There seems no connection between these temperatures and the results of the ordinary stability test at 110°.
C. A. S.

**4029. Spectrum and Photochemical Behaviour of Chlorine Dioxide. W. Finkelnburg and H. J. Schumacher.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 704–716, 1931.—The band spectrum of chlorine dioxide was measured by a streaming method employing a 2-m. grating. The third order spectrum was obtained and extended from 5225 to 2700 Å. The longer wave band showed definite fine rotation structure. The wave-lengths of seventy-seven lines in the visible spectrum were measured with an accuracy of 0·05 Å., and in the predissociation region with an accuracy of 0·5 Å. The predissociation was a dissociation of $ClO_2$ into $ClO + O$, a reaction which was not instantaneous, but was completed later. The probable structure of chlorine dioxide is discussed, and its photochemical behaviour is described.
F. J. B.

**4030. Applicability of Einstein's Law of Photochemical Equivalence. B. K. Mukerji and N. R. Dhar.** *J. Phys. Chem.* 35. *pp.* 1790–1794, *June*, 1931.—The energetics of fourteen photochemical reactions are studied. It is shown from these results and also by examining the literature that Einstein's law of equivalence fails in the majority of photochemical reactions. The results of the reactions are given for different temperatures and under radiations of different wave-lengths. It is shown that the quantum efficiency gradually increases with the frequency of the incident radiation. In general also the quantum efficiency increases with increase in the temperature of the reacting substances. Those reactions which markedly deviate from the law of photochemical equivalence are shown to be highly exothermal in character.
J. K.

**4031. Action of Light on Mixtures of Ozone and Chlorine. Part I. Results with Low Ozone Concentrations. A. J. Allmand and J. W. T. Spinks.** *Chem. Soc., J. pp.* 1652–1666, *July*, 1931.—Reference is made to the discovery of Weigert on the sensitisation of the photo-decomposition of ozone for blue light by chlorine as well as to the experimental work of Bonhoeffer. The present work re-investigates this reaction, particularly to test the relation between $\gamma$ and $\lambda$, where $\gamma$ is the temperature coefficient and $\lambda$ the wave-length. It is concluded that $\gamma$ is independent of temperature over the wave-length range covered. Part II will refer to more concentrated ozone mixtures, and will contain a discussion of the whole work.
J. K.

**4032. Optical Dissociation of Rubidium Iodide. A. C. S. van Heel and G. H. Visser.** *Zeits. f. Physik*, 70. 9–10. *pp.* 605–613, *July* 22, 1931.—Measurements with rubidium iodide by the line fluorescence method have demonstrated the optical dissociation of the salt into Rb $(2P_{1,2})$ and I $(2P_2)$. The fluorescent groups are excited by the aluminium lines at 1936 and 1990 Å., and by the zinc lines at 2025 and 2064 Å.; the zinc line at 2100 Å. is without effect. On the assumption of a limiting wave-length of 2080 Å. the calculated value of the heat of dissociation of the salt is 69 k. cal. per mol.
H. F. G.

**4033. Temperature Coefficient of the Synthesis of Hydrogen Bromide by $\alpha$-Particles. S. C. Lind and E. F. Ogg.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 801–806, 1931. *In English.*—A still smaller temperature coefficient is found than in thermal and photochemical reactions. This is partly due to an activation energy received from the α-particles, and partly to reverse reaction; this complication does not exist in the thermal and photochemical reactions. Special attention has been devoted to intermediate temperatures in this investigation. At 40° C. the thermal rate of reaction is negligible, and the α rate has the value $M/N = 0 \cdot 54$, where M is the total number of molecules of HBr formed by the production of N total ion pairs in a mixture of $1H_2 - 1Br_2$ gases; this agrees with the value previously found. At 100° C. the thermal rate over 165 hours becomes measurable; it is a little less than 1/6 of the total rate, and by difference $M/N = 0 \cdot 66$. M/N rises to a maximum of 1·51 at 192° C., and then falls rapidly, reaching zero at 265° C. Apparently M/N becomes negative above this temperature, which would mean a slower rate of synthesis in the presence of radon than in its absence. The investigation shows that the temperature coefficient of a complicated reaction is a complex function of the various steps which make up the net reaction, and cannot be clearly interpreted unless the effect of temperature on each step can be separately resolved.

H. N. A.

**4034. Galvanic Potential and Changes of Concentration. M. Andauer and E. Lange.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 247–256, 1931.—The change of potential of a galvanic cell with the change of concentration of those ions which defined the potential is discussed, and the thermodynamic theory is developed. The results of the theory are applied to the case of a simple cell Ag/AgNO$_3$, and to electrodes of the second kind. The potential determining changes in the system metal/solution of complex salt of the metal was also examined, and the combination Ag/0·05 AgNO$_3$ 1*N*.KCN/1*N*.AgNO$_3$/Ag was taken as an example. The results are in general agreement with the theoretical conclusions.

F. J. B.

**4035. Becquerel Effect. Part III. C. Winther.** *Zeits J. phys. Chem. Bodenstein-Festband, pp.* 341–351, 1931.—The work begun in Part II [see Abstract 1663 (1930)] is confirmed by the further investigation of the effect of the intensity of the light upon the electrical conductivity effect. An artificial Becquerel copper oxide electrode was prepared by heating a piece of copper foil 4 by 5 cm. in an electric muffle furnace. The copper oxide layer on the copper oxide electrode was found to have so low a resistance in the dark that the oxygen-concentration element CuO/Cu showed the maximum current strength. When the electrode was illuminated the conductivity of the oxide layer was proportional to the intensity of the light. An artificial Becquerel cell was prepared which showed the same relationship between potential and conductivity as the genuine Becquerel cell.

F. J. B.

**4036. Becquerel Effects with Bismuth Oxide Electrodes. A. Coehn and R. Mykolajewycz.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 641–655, 1931.—The behaviour of bismuth oxide as an electrode was investigated. The bismuth oxide was precipitated electrolytically, and the variation of its potential with illumination of the electrode by a Pintsch-Hela lamp was observed. It was found that the bismuth tetroxide which was present in the bismuth oxide was responsible for the sensitiveness of the electrode to light. The stability of the bismuth oxide, and consequently the potential of the electrode, depended upon the metal on which the oxide was deposited. Illumination of the electrode resulted in a fall of the potential. The reducing action of the light was dependent upon its wave-length. The quantum yield was very small, and was of the order of $10^{-5}$ to $10^{-4}$ elementary electrical charge per light quantum.

F. J. B.

**4037. Photovoltaic Cells with Silver—Silver Bromide Electrodes. Part I. B. Vanselow and S. E. Sheppard.** *Zeits. f. wiss. Phot.* 30. 1–2. *pp.* 13–39, *May,* 1931. *Kodak Research Lab. Comm. No.* 362.—A study of the Becquerel effect with electrodes of silver, coated with a thin film of AgBr (order of 0·0003 mm. thickness), and immersed in a solution of KBr. One electrode is kept dark, and the other exposed to light from a Cooper-Hewitt quartz mercury-vapour lamp. The precise method of preparing the electrodes, given in detail, is necessary to ensure reproducibility of results. As found by Tucker, the exposed electrode usually acquires a momentary negative charge when illuminated and then swings over rapidly to a positive potential which attains a maximum in about 2 min.; the potential-time curve is a function of the metal of the electrodes, the nature and thickness of the surface coating, and the composition of the surrounding medium. The initial "negative effect" is supposed to continue throughout exposure, being more than counterbalanced by the ensuing positive effect; for its investigation a triode voltmeter is found preferable to Tucker's potentiometric method, and an oscillograph is to be employed in further investigations. The suggested mechanism of the phenomena is as follows: the immediate effect of illumination is to split an electron from a $\mathrm{Br}^-$ ion, the electron is taken up by a silver ion ($\mathrm{Ag}^+$) on the electrode, and the remaining Ag atom then recombines with the Br atom which has attained the molecular state and has diffused to the surface of the metal. In support of this mechanism the following observations are adduced: (1) the "negative effect" is more pronounced, the thinner the AgBr layer (and hence the more electrons reach the metal); (2) halogen acceptors in the embedding medium depress the positive effect by allowing fewer Br atoms to reach the metal; (3) the positive effect is enhanced if the $\mathrm{Br}^-$ concentration in the medium is increased; (4) the time required for a given fractional decay of positive potential, on shutting off the light, is proportional to the AgBr thickness (diffusion of Br atoms); and (5) as required by the Nernst equation applied to $\mathrm{Ag} + \frac{1}{2}\mathrm{Br}_2 = \mathrm{AgBr}$, the positive potential is found proportional over a great part of the range to $\log(\mathrm{Br}_2)^{\frac{1}{2}}$, considering $\mathrm{Br}^-$ concentration under (3). Results are always most consistent when the cell solution is saturated with AgBr, thereby avoiding solution at the electrode surface.

L. V. C.

**4038. Rôle of Water in Photovoltaic Cells. R. Audubert.** *Comptes Rendus,* 193. *pp.* 165–166, *July* 20, 1931.—It had been shown in a previous communication [see Abstract 1661 (1930)] that the behaviour of photovoltaic cells was attributable to the action of hydrogen or oxygen which resulted from the decomposition of water by the light. Electrodes of CuI, $\mathrm{Cu_2O}$, CuO, $\mathrm{Ag_2S}$, $\mathrm{Hg_2I_2}$, were studied in various solvents, such as acetone, alcohol, ether, etc., which were rendered conducting by the addition of potassium iodide or sodium iodide. The potential was stable in all the solutions, and the conductivity was sufficient for the measurements to be made. In the absence of water the photo-potential was zero, or very small. The absorption of water restored the initial value of the photopotential. It is concluded that water is essential to photovoltaic phenomena, and that its influence is exerted chiefly in the adsorbed layer at the surface of the electrode. F. J. B.

**4039. Current Producing Reactions in the Leclanché Cell. C. Drucker.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 912–918, 1931.—The reactions which take place in the Leclanché cell are discussed, and the potential of the cell was calculated from the heats of the reactions. The temperature coefficients of cells made up with artificial and natural $MnO_2$, and with ammonium chloride, to which small amounts of zinc and mercuric chlorides had been added as electrolytes, were determined. It is shown that the kathode of an undischarged Leclanché cell behaved as an oxygen electrode. F. J. B.

**4040. E.M.F. of Cells of Two Liquids and its Dependence on the Dilution of the Solutions. L. Bouchet.** *Comptes Rendus,* 193. *pp.* 149–151, *July* 20, 1931.—The metals previously used, Mg, Zn, Cu and Ag [see Abstract 3204 (1929)] were associated two by two to build up electric cells, the metals being immersed respectively in normal solutions of their salts, the solutions being in separate containers connected by glass tubes constricted at one end and filled with one of the solutions. The following table gives results obtained with sulphate solutions:

| | Measured E.M.F. (volts). | Calculated E.M.F. (volts). |
|---|---|---|
| Mg–Zn | 0·709 | 0·713 |
| Mg–Cu | 1·810 | 1·804 |
| Mg–Ag | 2·275 | 2·266 |
| Zn–Cu | 1·089 | 1·092 |
| Zn–Ag | 1·502 | 1·498 |
| Cu–Ag | 0·444 | 0·431 |

Measurements were also made with chlorides, acetates and nitrates, but the results obtained were not so good as with the sulphates, especially in the case of the nitrates. To investigate the effect of dilution of the solutions the Zn-Cu combination was used. A normal solution of $CuSO_4$ was used, while the strength of the $ZnSO_4$ solution was successively reduced. The e.m.f.s measured directly were 1·089, 1·095, 1·114 and 1·128 volts for $ZnSO_4$ normal solution, *N*/10, *N*/50 and *N*/100 respectively. The corresponding figures deduced from association of the Zn electrode with a mercury electrode were 1·092, 1·097, 1·112 and 1·125 volts. For the element Zn, using chloride solutions, the e.m.f. increases at first with the dilution up to *N*/20, and then decreases again. With acetates and nitrates the results are irregular, and similar results are given by Mg and Cu. The irregularities may possibly be due to oxidation of the metals in the dilute solutions. A. W.

**4041. Theory of the Lead Accumulator. C. Liagre.** *Comptes Rendus,* 193. *pp.* 236–238, *July* 26, 1931.—Experiments were made to prove the identity of the peroxide of lead obtained by the treatment of red lead with nitric acid, with the peroxide produced on the positive plate of an accumulator. Further, it was shown that the variations in the acid content of the electrolyte when the cell was charged or discharged was in accordance with Faraday's law. The results were considered to allow the calculation of materials necessary per ampere-hour capacity of an accumulator. F. J. B.

**4042. Deposition Potential of Nickel. F. Foerster and K. Georgi.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 453–468, 1931.—The polarisation which takes place during the kathodic deposition of nickel from solutions of its single salt is studied. The form of the current density-polarisation curves is such that they are logarithmic, and from this circumstance it is concluded that the changes taking place during the deposition are retarded reactions. The previous work of S. Glasstone is not confirmed. F. J. B.

**4043. Change in Transference Number of a Salt with Concentration. E. R. Smith.** *Bureau of Standards, J. of Research,* 6. *pp.* 917–926, *June,* 1931.—A method for determining the rate of change of the transference number of a salt with change in concentration, based on a modification of the moving boundary method, is described. Junctions between solutions of the same salt at different concentrations are formed and the volumes through which the junctions move during the passage of known amounts of electricity are measured. The changes in transference numbers between the concentrations across the junctions are calculated from these data. The method was tested for solutions of lithium, sodium and potassium chloride. It was found that potassium chloride exhibits but little change in transference number on passing from dilute to 4·7 molal solution. AUTHOR.

**4044. Expansion of Electrodeposits of Certain Metals. C. Marie and N. Thon.** *Comptes Rendus,* 193. *pp.* 31–32, *July* 6, 1931.—The existence of stresses in electrodeposited metals has been shown by many observers. The deformations of a kathode when a metal is deposited on one side, the other being protected, were studied in the cases of copper, deposited from copper sulphate solutions alone and with the addition of sulphuric acid and of sodium chloride. The various factors affecting the nature of the deposit were examined, and the deformations are considered not to be due to hydrogen. The results showed that deposits of metals tend to dilate or to contract, and the conditions which affect this behaviour are of importance in the production of adherent deposits. F. J. B.

**4045. Ionic Mobility in Crystalline Solids. A. Smekal.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 443–452, 1931.—For the full expression of the temperature variation of the fraction of the total conductivity in a crystal which is due to each type of mobile ion a two-membered equation is necessary; the first member refers to the fraction of the conductivity which is dependent on the structure of the substance. The conductivity is influenced also by chemical, mechanical and electrical factors. Highly conducting compounds, such as $\alpha$ silver iodide and $\alpha$ silver sulphide, are considered in detail. H. F. G.

**4046. Ionic Mobility in Good-Conducting Solid Electrolytes. C. Tubandt and H. Reinhold.** *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 874–880, 1931.—From a comparison of the diffusion constants of good-conducting solid electrolytes on the one hand, and on the other of the diffusion constant and electrical conductivity of $\alpha$-$Ag_2S$ when pure, and also when charged with sulphur, it is concluded that, for the case of $\alpha$-$Ag_2S$, a different mechanism of transport must be assumed from that of solid electrolytes hitherto investigated. H. H. Ho.